

COSTS OF ILLNESS IN SWEDEN 1964–1975

BJÖRN LINDGREN

Lund
Economic
Studies

Lund 1981

COSTS OF ILLNESS
IN SWEDEN
1964-1975

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Lund University Studies Number 24

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For Elsa and Arne

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Acknowledgements

This monograph summarizes and joins together a major part of the results of various research projects in which I have taken part during 1976–1981. The projects have received financial support from several different sources, and most of the results presented here have also been published elsewhere.

Chapter 3, first section, is based on a study made for the Swedish National Bureau of Statistics, regarding the problem of measuring productivity changes in the public sector. The results have been published (in Swedish) in a memorandum from the National Bureau of Statistics (1979) and in *Statistisk Tidskrift* (1979). I am especially grateful to Lennart Fastbom and Ingvar Ohlsson for useful comments on these previous versions. The second section of the same chapter is based on a study for IHE, the Swedish Institute for Health Economics; the results have appeared in *Statistisk Tidskrift* (1980). Peter Hertzman's diligent research assistance is gratefully acknowledged.

The third section of Chapter 3 summarizes three studies on changes in the costs of specific surgical treatments: cholecystectomies, inguinal hernia repairs, and appendectomies. These studies were made in co-operation with surgeons from Lund University Hospital. My gratitude to them, in particular to Stig Bengmark, Bengt-Göran Petersson, and Ralph Sörbris, is great. As regards the appendectomy study we are indebted to Håkan Brodin for diligent research assistance. The cholecystectomy study was supported by grants from the Swedish National Bureau of Statistics and the Swedish Council for Research in the Humanities and Social Sciences; the two other studies form part of a research project financed by grants from The Bank of Sweden Tercentenary Foundation. The results of the cholecystectomy study have also been published in *Annals of Surgery* (1979).

The remaining chapters are based on the results of research projects supported financially by the Swedish Council for Research in the Humanities and Social Sciences and by the Swedish Institute for Health Economics. Most of the estimates to be presented in Chapters 4–7 have been published in "Health Accounts and the Costs of Illness – An Analysis of Intertemporal Changes in Sweden", which was the Swedish contribution to the European Workshop on Health Accounts, Université Paris – IX Dauphine, 12–14 March 1980. The estimates were also presented at the Nordic Health Economists' Group meeting at Frostavallen, 18–19 August 1980. The participants of these two conferences provided me with several comments and suggestions for which I am grateful. The diligent research assistance of Peter Hertzman is also gratefully acknowledged.

This final product has benefited not only from the critical remarks of the many persons already mentioned but also from helpful comments and suggestions from several others: Peter Hertzman, Bengt Höglund, Bengt Jönsson, Peter McGregor, Dorothy P. Rice, Anne A. Scitovsky, Ingemar Ståhl, Lars Söderström, Björn Thalberg, and Eskil Wadensjö. To Inger Lindgren for her enthusiastic help in the typing and retyping of manuscripts and to Hedvig Ahlbom for efficient administrative assistance, I am most grateful.

Any errors which remain, in spite of all expert advice I have received, are of course my sole responsibility.

Lund, October 1981

Björn Lindgren

1 Introduction

The true 'wealth of nations' is the health of its individuals. A nation consisting of weak, sickly, and short-lived individuals is poor compared with nation whose inhabitants are of the opposite type.
(Fisher, 1906, p. 176)

The expansion in the costs of health care is a widely recognized phenomenon in the Western, industrialized countries. In Sweden, current health-care expenditures have risen from SEK (Swedish kronor) 5 billion in 1964 to SEK 11 billion in 1970, and to SEK 40 billion in 1979, all in current prices. While the gross domestic product (GDP) at current prices has been increasing at an average annual rate of 10 per cent during that period, current health-care expenditures have shown an average annual rate of increase of 15 per cent. As a percentage of GDP, health care consumption has grown from 5 per cent in 1964 to 9 per cent in 1979, *i. e.* a relative increase of about 80 per cent in 15 years.¹

The reasons for the growth of health-care expenditures may be many: population growth; changing demographic trends that have led to an increasing share of elderly people; rising incomes; lowered consumer charges; changes in consumers' preferences; changes in medical technology, in particular those which have occurred in hospital care; and an inflation rate for health-related goods and services which probably is larger than the inflation rates of most other sectors of the Swedish economy.

During the same time that the Swedish economy has experienced seemingly ever-increasing health-care costs, a great number of new measures of preventing and treating many diseases and injuries have been developed. These advances provide the basis for more or less unlimited claims for resources to extend lives or to improve the quality of life. In some cases, the application of these new methods of prevention and treatment may also reduce existing health-care costs. In many cases, however, the use of new medical technology competes more directly with other possible uses of resources within the health-care sector as well as in other sectors of the economy.

While the technical possibilities of prevention and treatment are still improving and, thus, breaking the path for new potential demands on resources, there is now no or very little general economic growth which could provide the extra resources needed to satisfy this potential demand. Among other things, these facts have made policymakers realize that health care resources are scarce; and what is more, the resources necessary to meet the demands for health care seem to become increasingly limited. Policymakers in Sweden have answered this challenge by suggesting various measures which might be expected to curb the health-care cost expansion. Greater concentration on primary care and self care, which are assumed *a priori* to be cheaper forms of care, is one solution mentioned; a general reduction in the length of stay in

hospital after surgery has also been presented as a way of reducing the rate of growth of health-care expenditures; and there are several other suggestions made in the general political debate on health and health care, especially, of various kinds of preventive measures.

While the increasing awareness of scarcity among policymakers is a good thing *per se*, this growing realization should, hopefully, not result in too limited analyses of how to keep some health care costs down. An analysis of the economic gains of early discharge, for instance, must not be confined solely to the hospital sector or to the health-care sector. Shorter stays in hospital may mean more work for the patient's family. The fact that the extra work in the home is undertaken without payment does not mean that these are not costs. Only if the time of the husband, wife, relative or friend can really be assumed to have no opportunity value, will the cost to society be equal to zero. And such an assumption can seldom be justified, since the time devoted to the care of the discharged patient could, for instance, have been spent on paid employment and the production of goods or services. In the same manner, too early a discharge might mean a longer convalescence at home for the patient and, hence, lost output of goods and services, which the person might have produced, had he returned earlier to work.²

Similar arguments apply to all other proposals of measures to be used when attempting to reduce the expansion in the costs of health care. Obviously, health-care costs and the rate at which they are growing do not tell the full story about the economic burden of illness. Allowance must also be made for what are usually called indirect costs. The indirect costs of ill-health reflect the value of those goods and services that could have been produced had not a person fallen ill. In some cases the effects of such unproduced output are limited to a very short period, as when a person is granted a short term of sick leave to recover from an infection of the upper respiratory tract. In other cases the consequences extend for many years to come. For instance, a certain disease may prevail on a person to switch to an easier job, one that is perhaps also less well-paid. Another disease may so disable a person that he cannot work at all or only in part for a very long time. And then, of course, the disease may have a fatal outcome.

One may say that the indirect costs are a measure of the impact of ill health on the national income or on the productive capacity of a nation. Had it not been for the existence of various diseases, present or expected future production might have been larger. The idea of quantifying the impact on production from illness and accidents was given a major impetus by the interest in developing a human capital theory in the late 1950s and early 60s.³ The notion that good health means great wealth is, however, much older, as can be seen on p. 17. In fact, the interest among economists in the effects on national income or product from good or ill health can be traced back more than 300 years to the writings of Sir William Petty.⁴

This brings us to the rationale behind the study of the direct and indirect costs of illness which will be presented in this book. Before proceeding, however, I might emphasize that this apparent preoccupation with the production aspects of ill-health does not mean that

I consider these effects to be the most important ones. Evidently, pain, suffering, insecurity, and grief are the essential effects of illness, and their relief is the true aim of the health care system.⁵ However, ill-health and the promotion of good-health do have effects on production as well, and the analysis of these effects is but one of a series of important tasks to be done in health economics.⁶

The use of cost-of-illness studies: Two examples

To avert direct and indirect costs of illness has been considered as an important benefit in numerous cost-benefit analyses of various health projects. Two examples of such cost-benefit analysis will be given in the following. The first example is concerned with the question of how to allocate medical research funds, while the second one deals with the costs of a delay in the introduction of a pharmaceutical innovation.

First example: The allocation of medical research funds

How are scarce medical research funds to be allocated among different uses in order to give as much benefit as possible? In which areas of research are expenditures sub-optimal and to which areas should public research granting agencies decrease their awards? These difficult questions are discussed by Weisbrod (1961a).

Weisbrod suggests that information about the economic benefits expected from various health projects would serve as a useful indicator of the strength of demand and, hence, as a meaningful guide to expenditure decisions, for instance regarding preventive health care or medical research. By economic benefits in this context Weisbrod means savings in health care expenditures and increased productive capacity due to better health status of the population. For illustrative purposes Weisbrod selects three diseases: cancer, tuberculosis, and poliomyelitis. For each disease Weisbrod calculates as far as possible the costs of treatment and the expected loss of production due to the fact that people get ill for a longer or shorter period or because people die a premature death.

The results of Weisbrod's calculations of the economic costs of cancer, tuberculosis, and poliomyelitis are summarized in Tables 1.1 and 1.2. Cancer accounts for the largest costs, the costs of tuberculosis are approximately a third as great, and the costs of poliomyelitis are only a minor fraction of the costs of cancer. Treatment costs are most important for tuberculosis, while the mortality costs have large shares for both cancer and poliomyelitis. Only mortality costs have been discounted, and the choice of discount rate (Weisbrod uses 4 and 10 per cent) is of greatest relative significance for poliomyelitis because of the low average age of polio victims.

Table 1.1. "Total" economic costs from deaths and new cases of cancer, tuberculosis, and poliomyelitis in USA 1954; millions of dollars.

Disease	The sum of treatment costs and loss of production	
	4 % discount rate for mortality costs	10 % discount rate for mortality costs
Cancer	2,607	2,222
Tuberculosis	812	724
Poliomyelitis	71	46

Source: Weisbrod (1961a), p. 84.

Weisbrod then compares his estimates of the economic costs with available data on funds allocated to research on each of the three diseases. A necessary condition for optimal allocation of scarce research funds is that the expected marginal return per dollar is the same in all areas of use. Knowledge about expected returns within different medical research areas is naturally enormously uncertain. As to benefits there is hardly any better alternative in practice than to estimate potential savings of treatment costs and potential increases in production.

The results of Weisbrod's calculations of funds allocated to research on cancer, tuberculosis, and poliomyelitis in the USA 1946, 1948, 1950, 1952, 1954, and 1956 are reproduced in Table 1.3. Comparing these figures with the data on the economic costs given in Table 1.1, the amount of polio research seems to have been too large – relative to cancer and tuberculosis research. Weisbrod's conclusion is that we may be paying a rather high price for the Salk polio vaccine, since the disproportionately large volume of grants for polio research may mean the continuation of the far greater rates of morbidity and mortality of cancer, tuberculosis, and other diseases.

Weisbrod's conclusions would hold, if the probability of a pathbreaking discovery were approximately the same in all three areas. Expected benefits of research depend, not only on potential benefits, once these new results of medical research have been applied in practice, but also on the probability of making this decisive achievement. The great amounts of awards spent on polio research may, therefore, *ipso facto*

Table 1.2. Treatment costs, production lost due to morbidity and mortality, respectively, as percentages of total economic costs of cancer, tuberculosis, and poliomyelitis in USA 1954.

Disease	4 % discount rate				10 % discount rate			
	Treat-ment	Morbi-dity	Morta-lity	Total	Treat-ment	Morbi-dity	Morta-lity	Total
Cancer	14	26	60	100 %	16	31	53	100 %
Tuberculosis	48	21	31	100 %	54	23	23	100 %
Poliomyelitis	29	10	61	100 %	46	14	40	100 %

Source: Weisbrod (1961a), pp. 83–85.

Table 1.3. Awards by American National granting agencies for research on cancer, tuberculosis, and poliomyelitis in USA 1946, 1948, 1950, 1952, 1954, and 1956; thousands of dollars, current prices.

Disease	1946	1948	1950	1952	1954	1956
Cancer	618	5,021	6,722	8,309	12,166	17,810
Tuberculosis	30	657	546	576	540	590
Poliomyelitis	242	746	1,729	2,744	1,920	1,962

Source: Weisbrod (1961a), pp. 88–89.

be a natural consequence of the fact that the polio problem seemed to be close to its final solution in the late 40s and early 50s.

Of course, it is not entirely satisfying that significant health effects are omitted when an economic evaluation of a health project is being made. Important work is now going on in order to develop methods by which to measure various health aspects such as pain and suffering. However, there is really no perfect method available anymore than there was 20 years ago, when Weisbrod's book was published. We shall probably have to wait many more years before all health effects can be measured and transformed into monetary units. In the meantime calculations of treatment costs and loss of production could still give some valuable information.

Second example: The costs of a two-year delay in introducing pharmaceutical innovations

In his study of the 1962 amendments to the Food, Drug, and Cosmetic Act, Peltzman (1974) among other things made estimates of the economic effects of a delay in introducing a pharmaceutical innovation. For instance, Peltzman's results show that a two-year delay in introducing such drugs against tuberculosis as streptomycin, isoniazid, and PAS (now introduced in the late 40s and early 50s) would have meant that another 112,800 Americans would have fallen ill and 44,100 died from tuberculosis. According to Peltzman's estimates these increases in tuberculosis morbidity and mortality would be equivalent to at least \$ 2 billion in increased health care costs and loss of production. If the introduction of the polio vaccine (now introduced 1956) had been delayed by two years, this would have led to a loss of benefits, amounting to \$ 150 million spread over 70,000 additional polio victims.

Peltzman further illustrates this point by calculating the economic effects of a two-year delay in introducing a major therapeutic advance not existing at present. Peltzman here chooses two leading causes of death: heart disease and cancer. Both diseases have been the subject of extensive pharmacological research for quite a long time, but so far without any real breakthrough. Peltzman first calculates the economic costs of these two diseases, then the expected reduction in these costs due to a decline in the number of deaths from heart disease and cancer made possible by a new (hypothetical) drug, and finally

Table 1.4. Expected costs of two-year delay in introducing innovations that would reduce mortality in heart disease and cancer in USA by 5, 10, and 25 per cent, respectively. 1970 prices and population.

Reduction in mortality	Heart disease		Cancer	
	Thousands of lives	Millions of dollars	Thousands of lives	Millions of dollars
5 %	76.5	1,239	33.3	679
10 %	153.0	2,478	66.5	1,357
25 %	382.6	6,193	166.3	3,393

Source: Peltzman (1974), p. 70.

the expected costs of a delayed introduction. The latter results are reproduced in Table 1.4. They clearly show that also a delay in the introduction of a drug which makes a comparatively small reduction in the mortality rates would cost tens of thousands Americans their lives and the US economy several billion dollars. These estimates, as well as the ones reproduced above, were based on 1970 prices and the 1970 American population.

A more strict control of new drugs, requiring an increased number of clinical testing, may increase the probability of finding negative side effects of a harmful drug, which *per se* may mean that many human tragedies are avoided. At the same time there is the risk that a potentially beneficial drug is prevented from reaching the market. Peltzman used the cost-of-illness approach to emphasize the fact that a substantial delay in introducing a significant innovation may also lead to many unnecessary human tragedies and very high economic costs. The idea was, naturally, to compare the benefits of a more strict control of new drugs with the costs of a delay in introducing a new drug, benefits and costs both being expressed in terms of lost lives and output. Peltzman's method has limited applicability, though. It might, for instance, be argued that measures taken in order to encourage the births of new Americans could yield more net benefits in terms of output than a not so strict control of new drugs.

Partial and total cost-of-illness studies

The studies presented above are two among many examples which could be given of the use of cost-of-illness estimates in cost-benefit calculations. There have been made numerous studies on the direct and indirect costs of illness for specific activities, diseases, and conditions.⁷ A few additional examples from the USA are: Fein's analysis of mental illness (Fein 1958), Klarman's study on syphilis (Klarman 1965), Weisbrod's study on the benefits of polio research (Weisbrod 1971), and Acton's study on heart attacks (Acton 1973). Recently Harunian, Smart, and Thompson (1981) published their results concerning the economic costs of the annual incidence of coronary heart disease,

cerebrovascular disease, cancer, and motor vehicle injuries. Another recent study is the analysis of social and economic implications of the prevalence of cancer made by Rice and Hodgson (1981).⁸

There have been some studies on the costs of illness for specific activities, diseases, and conditions also in Sweden: traffic accidents (Mattsson 1968), poliomyelitis (Lindholm 1973), occupational injuries (Dahlberg and Grenninger 1974), smoking (Jonsson 1974), hypertonic diseases, acute heart infarction, and cerebrovascular diseases (Dahlberg *et al.* 1975), diseases of the musculoskeletal system (Hertzman 1979), peptic ulcer (Hertzman, Jönsson, and Lindgren 1979), asthma (Thompson 1981), and diabetes (Jönsson and Persson 1981).

One problem with such partial studies is, however, to determine the reliability of their results. Methodology may differ, making comparisons between studies impossible, and the sum of all independent estimates may not come very close to the total costs of illness, which often can be more accurately estimated from other sources. The following example illustrates this problem. In the USA there have been five separate studies on the costs of mental illness, all estimating costs in different years.⁹ According to these studies the direct costs of mental illness increased by a factor of 4.6 from 1963 to 1971, while total health care expenditures rose by a factor of 2 during the same period of time. However, 50 per cent of the apparent increase in direct costs between 1968 and 1969 are due to methodological differences between two of the studies. Moreover, the exact effects of the differences in methodology used in all the five studies are not known, not even for the direct costs of mental illness; the differences are, naturally, still greater for indirect costs.

The best way to achieve comparability would be to calculate the total direct and indirect costs of all illnesses and further distribute this total figure by disease category in one and the same study. There are very few studies of this kind available at present. There is the pioneering work by Rice (1966) and the studies by Cooper and Rice (1976), and Berk, Paringer, and Mushkin (1978), which cover 1963, 1972, and 1975, respectively, for the USA. Recently, there has also been published a forecast on the costs of illness in the USA for the year 2 000 (Mushkin *et al.* 1978), and estimates of the total costs of illness for 1900, 1930, and 1975, distributed by disease category, have been used in order to illustrate the benefits of biomedical research (Mushkin 1979).

There is also a study for Finland 1972 (Hemminki 1977). The only study on the total direct and indirect costs of illness made in Sweden prior to the present one is by Rydenfelt (1949), and it deals with Sweden 1945.

One of the advantages with total cost-of-illness studies is that they can provide a feel for whether the results of a partial cost-benefit or cost-effectiveness study, using direct and indirect costs, may seem plausible. All partial studies must, obviously, add up to the grand total. Single-year estimates may give some idea of the economic impact of illness, but estimates of the economic costs of illness do not have their main importance, if they are confined to one single year or one single country.

Calculations of changes in the costs of illness from year to year are

still more important. A description of the development of the costs of illness distributed (1) by type of cost and (2) by disease category may form the basis for an analysis of the factors underlying the growth of the health care sector and the effects of a changing disease pattern. It would also be possible to analyse the effects of various active policy measures taken by government. So, providing the data necessary for intertemporal comparisons is another important use of total cost-of-illness studies.

A third use of total cost-of-illness studies is to enable comparisons between countries. For instance, observed differences between countries in the shares of a certain disease may serve as the point of departure for further analysis: Are there differences in the incidence or prevalence of the disease? If not, what differences in the treatment of the disease may explain the discrepancies in the costs of treatment, morbidity, and mortality? What differences may be explained by health care policies varying between countries?

Estimating the costs of illness. Three approaches

In order to facilitate intertemporal or international comparisons, the cost-of-illness studies have to use consistently the same methodology. Divergencies in results may be due more to differences in the method of measurement or in the way, by which various problems of measurement are coped with, than to actual differences. First of all, there are three different measures which can and have been used in estimating the costs of illness. Say, for instance, that the costs of illness in 1975 are to be estimated, then the three measures are: (1) costs of illness due to the prevalence of disease in 1975, (2) costs of illness due to the incidence of disease in 1975, and (3) the economic burden of disease which is actually borne in 1975.

Prevalence is defined either as the number of cases of a specific disorder existing at a certain time or as the average number of cases existing during some specified period of time, most often a calendar year. Thus, the prevalence approach provides an estimate of the economic burden, discounted to 1975, resulting from the prevalence, or existence, of disease in 1975. In principle, this measure includes costs of resources used during 1975 for prevention, diagnosis, treatment, rehabilitation, and long-term care; output lost during the year due to short-term illness; and output lost due to permanent disability and deaths in 1975. Because a death or a permanent disability means lost output not only during 1975 but also in future years, the present value of the future production losses is counted. It should be noticed that the calculation of future losses would be based on the existence of morbidity in 1975, and not on the onset of a disease in 1975. The underlying cause of a premature death or a permanent disability in 1975 may well be the onset of a certain disease in 1968 or 1972. In the prevalence approach, however, the costs of a permanent disability or a premature death will then be counted in 1975.

Whereas prevalence is a stock concept, incidence is a corresponding flow concept. So, while the onset of the disease is not relevant to estimating the costs of illness, following the prevalence approach, it is important in the incidence approach. *Incidence* is defined as the estimated number of new cases of a disorder that have their onset during a certain period of time; the incidence, too, is normally calculated for a calendar year. Thus, the incidence approach provides an estimate of the economic burden, discounted to 1975, resulting from the incidence of disease in 1975. Because of illness starting in 1975, a person may need treatment not only during the same year but for many years ahead; she may lose time from work during these periods of illness; and she may eventually die of the disease which struck her in 1975. In principle, the measure based on the incidence approach includes all present and future costs of health care resources used due to the onset of the disease in 1975. It also includes expected present and future losses of output. So, this measure requires knowledge of the incidence of the disease in 1975 and the expected course of the disease, including sickness, disability, and mortality as well as treatments most likely to be used.

In the third approach interest centres on the economic burden of disease that is actually borne in 1975. This approach provides a measure which consists of health-care costs in 1975, production lost due to morbidity and mortality existing in 1975, and the value of output lost in 1975 because of morbidity and mortality in previous years. Present values of future losses of production due to morbidity and mortality in 1975 are not included in this measure, so no discounting is needed.

The three approaches will give the same estimates of the direct and indirect costs of acute conditions with short duration and no future effects. In that case the three approaches will assign all costs to the same year. In many, or rather, in most cases the three approaches will, however, provide quite different results.¹⁰

First, the third approach, *i. e.* the one where the economic burden, which is actually borne during the year, is studied, will generally produce results, which are larger than those of the prevalence approach which in its turn, will give estimates higher than those of the incidence approach. This reflects the fact that no discounting is used in the third approach, and that some costs are not discounted in the prevalence approach which are discounted in the incidence approach. The greater the discount rate used, the greater will be the differences between the results of the three approaches.

Second, the discrepancies between the results of the three approaches grows with the average duration of the disease or condition. The reason is the same as the one just mentioned. Costs are discounted to a larger extent in the incidence approach than in the prevalence approach, and no discounting at all occurs in the third approach.

Third, the differences between the results of the three approaches for a given disease or injury will generally be higher, *ceteris paribus*: (1) when incidence is declining (since the prevalence approach and the approach, where the economic burden actually borne during the year is calculated, both include the costs of chronic disease for the larger

incidence in previous years); (2) when annual treatment costs for the disease or condition are declining over time, for instance, because of the development of less expensive medical technology (since this fact should be reflected when future direct costs of present incidence cases are calculated; the other two approaches will both provide identical results, however); and (3) when annual treatment costs and disability losses rise over the course of the disease or injury (since greater costs will be discounted in the incidence approach than in the other two approaches; these other two approaches will produce identical results as far as treatment costs are concerned, the prevalence-based results, however, being lower for indirect costs).

The preceding discussion might lead to the conclusion that the economist, when choosing between the three approaches, can deliberately manipulate the results in favour of his own views. If the economist for some reason wishes to exaggerate the economic burden of a certain disease or condition, he would not use the incidence approach. The three approaches are not complete substitutes, however; the appropriateness of a specific approach depends on the purpose of study. The apparent arbitrariness vanishes, when the purpose of study is taken into account.

The third approach is rarely used. The economic burden of cardiovascular disease and cancer actually borne in USA 1962 due to costs of treatment and morbidity costs in 1962 and to premature deaths in 1962 as well as in previous years (no future effects included) were, however, estimated by Rice (1965). The same approach was followed by Lindholm (1973), when estimating the economic effects of the public polio-vaccination programme in Sweden. This approach provides a measure of the economic burden currently borne because of present and past existence of illness. It is less appropriate when various future policy options are to be evaluated.

The incidence approach provides the best measures of the costs that may be averted by programmes aimed at preventing a new case of the disease or injury or at immediate rehabilitation and the arresting of illness progression. The cost of incidence is, however, extremely difficult to estimate. It requires knowledge or good projections of the likely pattern of disease and treatment from onset to death. Such knowledge is seldom available, and the incidence approach has rarely been used. The most thorough incidence-based cost analysis to date is the study on the costs of incidence of cancer, motor vehicle injuries, coronary heart disease, and stroke, in the USA 1975, made by Hartunian, Smart, and Thompson (1981).

Most commonly employed is the prevalence approach. Estimates of the costs of illness, following the prevalence approach indicate the costs due to the existence of different diseases. Such measures can provide political decision makers with information useful when various kinds of cost-containment methods are evaluated. The prevalence approach is also the most suitable approach when evaluating the effects of new medical technology aimed at reduction of current direct costs or the improvement of productive capacity in the *prevalence* population. One great advantage of the approach is that double-counting is rather easily

avoided since all direct costs, at least, must add up to the total health care expenditures as given in the national accounts, for instance. The prevalence approach is the only approach used to date when estimating the total direct and indirect costs of illness, distributed by all main disease categories.

So, rather than competing, the three approaches complement each other. Neither one is the superior methodology under all circumstances, but each provides a useful basis for analysis and valuable information that supports the interpretation of the results of the other two approaches.

Study scope and objectives

The present study seeks to estimate the development of the total direct and indirect costs of illness in Sweden between 1964 and 1975, following the prevalence approach. The intention is also to distribute the estimated total costs of illness by main disease categories.

As the first year of study 1964 was chosen, because that is the first year from which detailed data on the distribution of inpatient care are available. It might have been possible to expand the estimates by including another year, or two at most. In 1976, however, the age at which old age pension normally starts to be payable was lowered from 67 to 65. By excluding 1976 (and 1977) I have deliberately avoided the problems of separating the effects of lowered retirement age from those of the prevalence of illness. Besides, only one or two years could have been added with available data, after all.

The prevalence approach was chosen as the single approach to be used in this study simply because of data availability. Published data necessary for estimation following the other two approaches are non-existent or rare, and the collection of primary data was impossible given the resource constraints on the study. Some information will certainly be omitted as a consequence of following only one approach, and by not being able to compare the results, especially between the prevalence and incidence approaches, but the prevalence approach is a useful method also in its own right. The prevalence approach is suitable when the object is to analyse the economic effects of prevalence of disease, and it provides a method of expanding the national economic accounts into the health-care field and, hence, into some kind of health accounts.

The distribution of the total costs of illness by main disease categories follows the International Classification of Diseases accepted by the World Health Organization, WHO. In that classification diseases and injuries are divided into 17 different main categories. This seems to be a useful classification in this context, since the direct and indirect costs are related to specific diseases or categories of diseases, since most new therapies are introduced with specific conditions as their chief aims, and since many policy measures are directed toward specific diseases and injuries.

The analysis of the development of various main disease categories

is analogous to the analysis of major industries as classified, for instance, in the national accounts. Naturally, precisely as with analyses of structural changes in the economy, the division between major categories may sometimes be too broad. Analyses of the costs of some specific diseases may require much more detailed estimates than the ones presented in this study. For the purposes of the present study, however, 17 categories seem to be a very suitable number to handle. Comparable studies in the USA and Finland have also used this level of aggregation.

In any case, available data do not always permit a more detailed analysis. Some data sources (relating to mortality and hospital utilization for instance) are more detailed than others (primary care and absenteeism). So the fact that only secondary data were used in this study also put some restraints on the level of aggregation which could be used. The resource constraint also made it impossible to fill the still existing gaps in data, even at the aggregate level. Diagnosis-related data are, on the whole, rare for primary care and absenteeism.

Finally, it might be emphasized that this study is not primarily concerned with the costs and benefits of specific health programmes. Moreover, estimates of the direct and indirect costs of illness are centred upon the production and investment aspects of ill-health. Loss of production is a measure of the cost of illness which, at best, may serve as a conservative indicator of the benefits to be gained if averted by a specific health programme. Important personal and social aspects are missing, and I fully recognize that the estimates do not tell the complete story of the impact of disease and injury.¹¹ No comprehensive index can be the answer to all questions, however. The official gross-domestic-product concept, for instance, is an imperfect measure of total output of the economy, but has, nevertheless, been useful for specific types of economic analysis, notably business-cycle analysis.

Concepts, data needs, and some problems of measurement

It may be useful to briefly survey concepts used, data needs, and problems of measurement and estimation, given the object of estimating the costs of illness following the prevalence approach. In this section definitions of direct and indirect costs of illness will be given. Questions as what data are needed, what data are available at present, and when are imputations necessary will be stressed, too. There will also be some discussion of such problems of measurement and estimation as the value of unpaid work in homes, the effect of unemployment, and the choice of the appropriate discount rate when converting a stream of future losses of production into its present worth. Finally, the distinction between transfer payments and costs will be emphasized.¹²

The direct costs of illness

Definition. Direct costs are all the costs of prevention, detection, treatment, rehabilitation, and long-term care due to the existence of diseases and injuries.

Data needs. The direct costs are mostly costs of the health-care system. To some extent it may, in practice however, be hard to separate direct costs of illness from other costs of care, for instance, for the elderly. In addition to the costs of the health-care system there are various preventive measures taken in order to avoid the diseases. The additional cost of seat-belts in cars, filter-tip cigarettes and water fluoridation are examples of such costs.

There are also other non-health sector direct costs. Costs of transportation to hospitals and physicians is one example. Illness can further incur additional expenses in caring at home, for instance household help for cleaning, laundering and cooking; special diets; and items for rehabilitation such as exercycles. There may also be costs of retraining and reeducation.

In theory, all the costs of the health care system as well as the non-health sector direct costs are included in the concept of direct costs of illness. In practice, however, there are limitations to what can be covered in the estimate of the direct economic costs. Non-health sector costs may be important; Mushkin (1979) has estimated that these costs would add between 9 and 16 per cent to the total health care costs in USA 1975. In spite of the fact that it represents an underestimation, most estimates of the direct costs of illness to date refer only to the costs of the health care system.

In Sweden, the costs of the health-care system are easily available in the national accounts. There, the total figure have also been subdivided by types of medical service or provider: hospitals, physicians, dentists, etc. These figures, however, have to be adjusted in order to take into account that primary care also takes place in the hospitals. The distributions of physician visits and inpatient care among disease categories are so different that inpatient costs and outpatient costs should be estimated separately.

Having made the estimate of the inpatient costs in total, these costs must then be distributed by disease categories. Inpatient statistics are readily available, including admissions and bed days distributed by disease or disease category. Data on the costs of treatment or bed day distributed by disease or disease category are harder to find, but in the present study it was to some extent possible to take into account the fact that the bed-day cost differ among diseases and, hence, to give them different weights when estimating the distribution of inpatient costs by categories.

Data on physician visits distributed by disease categories and on the costs of different kinds of physician visits are not very easy to obtain. In the Finnish study, for instance, estimates of the outpatient costs by categories were completely lacking. The lack of data is, of course, understandable. In many cases, the physician's diagnosis will turn out to be that you are at perfectly good health. Questionnaires to be filled

in by doctors may, however, lead them to give some sort of disease as their diagnosis, when it might be more true that they either feel unsure of the diagnosis to be made or actually consider you to be healthy. Nevertheless, the present study uses the results from such a study, comprising an extremely small portion of the Swedish population.

Multiple diseases. One of the problems of measurement has been touched upon – the fact that bed days are not homogeneous and, hence, cost differently. Another problem is the presence of multiple diagnoses. In all total cost-of-illness studies to date the allocation has been based on primary diagnosis only. Ideally, some of the costs of treating a patient in hospital or of a physician visit should in many cases be referred to other than the primary diagnosis.

If the second or third diagnosis are within the same disease category as the primary diagnosis, then the distribution by categories will not be affected by the use of the primary diagnosis. This distribution will not be affected either, if the associated conditions are fairly evenly spread over the disease categories, so that diseases of the circulatory system, for instance, are present among patients with primary diagnosis in other diseases as much as these other diseases are present among patients with diseases of the circulatory system as their primary diagnosis. These conditions are, however, certainly not satisfied, why the generally used method of allocating costs by primary diagnosis causes distortions, but by how much and in what direction is impossible to say at present.

The indirect costs of illness. Short-term illness

Definition. The indirect costs of illness consist of the loss of production due to the existence of diseases and injuries. The indirect costs due to short-term illness are confined to periods of sickness or disability less than a full year.

Data needs. In order to make a satisfactory estimate of the loss of production the data needed for each disease category are: (1) the average duration of short-term illness it causes, (2) the age- and sex-distributions of its cases, and (3) the average earnings of its victims, by age and sex.

Average earnings, including nonwage labour costs, are generally used to measure the size of the production loss. The value of production and earnings are roughly the same only for the marginal worker. Although different forms of imperfections on the labour market can admittedly invalidate this equality to some extent, in most cases the wage makes an acceptable, approximate, measure of the value of production. Thus, if a man, age 45, is unable to work during in average three weeks during a year because of the presence of a disease, the estimated loss of his production will be $3/52$ of the average annual earnings of men, 45 years of age.

The average earnings of the population are generally used as an approximation of the average earnings of people getting sick. These data

are usually readily available in most countries. It may be more difficult to find any data on the total amount or the distribution of short-term illness by disease categories. In Sweden (and Finland) there are national health-insurance data which could be used, at least to some degree. Data could also be collected in health-interview surveys as in the USA.

Law of diminishing returns. There are several problems of measurement and estimation connected with the estimation of the loss of output. The presence of multiple diagnoses is, naturally, a problem even in this case. Another complication lies in the fact that the increased labour inputs which result when illness declines should normally cause the production value for each new man-hour to decline in accordance with the "law of diminishing returns". Our calculation is based instead on the assumption that the production value for each newly available man-hour is constant. That can be defended in part by saying that the resource usage would presumably increase marginally for all different types of uses if morbidity were to fall off. Be that as it may, the common mode of calculation is bound to overestimate the production loss to some extent, *ceteris paribus*.

In some measure this overestimating tendency can be offset by the underestimating tendency which surely arises when calculating the effects of short-term illness. If a person is ordinarily a member of a gang, team, crew or the like his absence on account of illness may also have effects on the productivity of his workmates, in which case the production loss will be greater than the wage.

Unemployment. Full employment is a commonly used assumption in cost-of-illness studies. But some sick people of able-bodied age would lack productive employment even if they were healthy. Sometimes, moreover, a sick person can be replaced by someone who would otherwise be unemployed. In both these cases the assumption made tends to overestimate the production loss.

This overestimate is insignificant, however, if the rate of unemployment is so low that the unemployment is more of a searching, frictional or structural character than a business-cycle phenomenon. When this is the case, it is only by way of exception that a sick person can be replaced by a jobless person, and that is when the out-of-work has more or less the same knowledge and experience, lives in the same district and is willing to undertake that particular job. Thus, "full employment" is considered to exist when the registered rate of unemployment is 4-5 per cent in the American cost-of-illness studies and 1-2 per cent in the present study.

Unpaid household work. The preparation of a meal or the cleaning of a car is an example of productive activity regardless of whether the work is remunerated or not. At the time of registration, however, a difference arises in the official measure of society's total production, GDP. The gross domestic product is confined to production within the private business sector and the public sector agencies. The value of that production is easier to determine, at least in the former case. Nevertheless, the difficulty of valuing the output of non-market production in the households must not keep us from making the attempt and impute a shadow price to household work.

Although the various household activities are performed without direct remuneration, the performance of comparable services may be purchasable in the market. This has been the starting point of the American cost-of-illness studies. In the early studies, the estimates of the value of a housewife's work were based on the salary of housekeeper for an average family and the value increasing with the number of family members. The most recent cost-of-illness studies use estimates based on a time-motion study of housewives. The various services performed within the household were multiplied by the relevant market wages for these services.

In the present study, the point of departure was, instead, that household work should be valued in accordance with the alternative market occupation which the person currently working at home might get. There are obvious difficulties in determining what the alternatives really might be. However, in this study exactly the same value was attached to different forms of housework as to the average market wage paid for an ordinary occupation. This is not an altogether unreasonable approximation even though it is not wholly unobjectionable. One may, for instance, argue that a person may benefit from participating in household activities up to a point where his marginal productivity is lower than in his market activities, since only income from market activities is taxed. (This remark is also valid of the first method mentioned above.)

Other indirect costs. In theory, indirect costs include the value of the time spent visiting physicians, other health professionals, and hospitalized persons by patients and family members. In practice, the estimates may be confined to the patients and to the time patients are sick-listed. In theory, indirect costs also include the value of time lost from work by members of family when someone in the family is ill and needs some caring at home. All these indirect costs were excluded from the present study.

The indirect costs of illness. Permanent disability

Definition. The indirect costs due to permanent disability consist of the loss of output due to a permanently disabling condition, caused by the prevalence of disease.

Data needs. The information required is similar to the case of short-term illness: (1) expected average duration and severity or intensity, (2) the age and sex distributions of all disease categories, and (3) average earnings of the population by age and sex.

There are no perfect data on the expected average duration, nor on the severity or decrease in productive capacity. In this study, Swedish national insurance data concerning early retirement were used as indicators of permanent disability. The average duration was taken to be the expected time to normal retirement age, even though people may continue being productive also after legislated retirement age. Furthermore, some people with full disability pensions may still be able to produce, say 40–50 per cent of what they used to do, but the present estimates do not take this fact into account.

The calculation also requires data on survival probabilities, but such data are readily available in official statistics. The method of calculation is principally the same as for premature death, see below.

Problems of measurement and estimation. The same kinds of measurement problems apply here as in estimating the short-term illness costs.

The indirect costs of illness. Premature death

Definition. The indirect costs due to mortality consist of the loss of output due to premature death.

Data needs. (1) The age and sex distributions of death by disease categories, (2) average earnings of the population by age and sex, and (3) survival probabilities by age and sex.

All the data needed are, in general, easily available. Some imputations must be made, however, for household work.

The expected loss of output may then be calculated by means of the following formula:

$$V_a = \sum_{n=a}^r \frac{P_{an} W_n}{(1+i)^{n-a}} \quad (\text{Eq. 1.1})$$

where V is the present value of future incomes, a is the person's age at his last birthday, P_{an} is the probability that a person of age a will live till he is n years old, W_n is the average earned income (including nonwage labour costs) of persons working full time who have reached the age of n , r is the normal retirement age, and i is the discount rate.

The discount rate. Obviously, many of the problems of measurement connected with the estimates of loss of production due to short-term illness also apply to mortality costs. In addition there are the problems of discounting and lost consumption. The calculation of the present value of expected lifetime earnings raises the question of choosing the appropriate discount rate. The value of goods and services that are offered for delivery in two years or ten years is generally lower for the consumers than the same goods and services that can be delivered today. This is true even in situations where we are certain to get the goods or services at the future date, or where there is no inflation. When uncertainty and inflation are present, we would typically demand even higher premiums for postponing our consumption. This justifies the use of discounting. In the following we only discuss discounting the value of goods and services in constant prices, however.

The choice of a suitable interest rate is a more difficult matter, one that has been keenly debated, see *e. g.* Baumol (1968) as well as Fisher and Krutilla (1975). In view of the inverse relationship between the present value of future production losses and the discount rate, the size of the indirect costs of illness will be strongly affected by the choice

of discount rate. According to a fairly wide consensus, the appropriate discount rate lies somewhere between 2.5 and 10 per cent, but this consensus leaves us with a rather wide range of discount rates which may be used. The discount rate can also be adjusted to take expected changes in labour productivity into account. For instance, a 6-percent discount rate adjusted for an annual 2-percent rise in labour productivity will yield an effective discount rate of approximately 4 per cent.

Consumption. A death implies the loss of a producer. It also involves the loss of a consumer. In the past, it was therefore sometimes argued that the mortality cost is an individual's output minus her consumption (Weisbrod 1961a). In such calculation "society" is defined as to exclude the individual whose productive life is being valued. Today, most economists seem to agree that consumption should not be deducted, thereby defining "society" to include everyone, including the individual whose productive life is being valued. Even if one chooses the latter definition of society, it might be argued that some consumer expenditures, now registered as consumption in the national accounts, are necessary for keeping human capital intact and, hence, expenditures to be deducted when the output of the economy is to be estimated. Nevertheless, no part of "consumption" is deducted from earnings in the present study. The same procedure was also followed in the American and Finnish studies, with which comparisons will be made in Chapter 7.

The distinction between transfer payments and costs

It must be observed that transfer payments such as sickness cash benefits or disability pensions are not costs of disease. Transfer payments should, therefore, not be added to direct and indirect economic costs. Transfer payments do not affect the total output of goods and services in the economy, but they are simply a redistribution of income from one group of individuals (the wage earners) to another (the sick and disabled). To add certain transfer payments to the production loss implies double-counting, since all the indirect costs are already included in the loss of production. Failure to make a distinction between transfer payments and costs will result in a serious overestimate of the costs of illness.

Transfer payments, naturally, do have other important effects, for instance, the compensation of victims of disease for their lost earnings. For this reason, it may be desirable to investigate the redistributive effects of the system of transfer payments, although these aspects cannot be covered in the cost-of-illness framework. One important question is to study the amount or extent to which the victim of disease must personally bear the economic costs of illness. This has been investigated by Hertzman (1979) in a study on the social and economic consequences of rheumatic diseases. His results are reproduced in Table 1.5.

The costs of rheumatic diseases in Sweden 1975 were SEK 7,349 million, according to Hertzman's estimates. Persons other than the victims bear 90 per cent of the costs. When the victims themselves have to bear a large part of these costs, it is chiefly in connection with long

Table 1.5. Economic costs and transfer payments ensuing from rheumatic disease in Sweden 1975, by victim and rest of society, in millions of kronor.

	Victims	Rest of society	Total
Treatment costs	50	886	936
Occupational therapy	0	135	135
Permanent disability	610	3,434	4,044
Short-term illness	60	2,174	2,234
Total	720	6,629	7,349

Source: Hertzman (1979).

periods of illness, which in turn qualifies them for superannuation at a lower rate. Had they been compensated in full on the occasion of such early retirement, they would have received SEK 1,420 million. According to Hertzman's calculations, the most compensation they can get is a mere SEK 800 million, which worsens their economic situation by about 40 per cent. A much better deal befalls groups with short-term illness, the compensation amounting to just over 90 per cent. The result clearly shows how the Swedish social security system pays good compensation for short-time absence, while prolonged illness and disability can sharply deteriorate the living standard of the private individual.

So, while the value of transfer payments *per se* is not a cost of illness to society, it would be most valuable to investigate the redistributive effects of transfer payments. This is, however, beyond the scope of this study.

Tentativeness of results

Evidently the estimates that will be presented in the following chapters depend on a number of assumptions and on data sources of varying quality.

Some of the assumptions and data used affect the estimated distribution of costs by categories only, leaving the total costs unchanged. This is true of the data on the utilization of primary care and inpatient care used for allocating the total health-care costs by disease category. The data used from smaller or larger sub-populations of the Swedish population may, naturally, not be representative of Sweden as a whole. Furthermore, available data on costs do not separate between different diseases, so all possible differences in treatment costs cannot be identified.

Other assumptions affect both the estimated size of the total costs and the estimated distribution. These assumptions include, for instance, the choice of a suitable discount rate. The higher the discount rate chosen, the lower will be the total indirect costs. At the same time, however, the higher the discount rate, the lower will be the shares of such disease categories as accidents, where people are often struck by disability and premature death in their early ages. In the present

study 4 per cent was chosen to be a suitable discount rate in the base case, not because it was considered to reflect time preferences of the Swedes better than any other discount rate, but because it is a widely used discount rate in studies of this kind. As indicated above, however, many economists argue that the proper discount rate would be closer to 10 per cent, and still others feel that a value closer to 2–2.5 per cent would be more appropriate.

Still other assumptions affect mainly the estimated total level of the costs of illness. An example is the assumption that average earnings can be used as a sufficiently good approximation of the value of lost output. Earnings vary, however, between people in each sex and age group, and using the first or second decile groups instead of averages would, obviously, diminish the size of the total indirect costs.

Because the reliability of many data is uncertain and since most assumptions that must be made, while not totally unreasonable, are still debatable, the prudent analyst should always try to determine the range of possible values of the data to be used and of reasonable alternative assumptions. The analyst will then be able to recalculate the costs of illness using other sets of data and assumptions. Through this process it becomes evident whether or not the estimated total costs or the estimated distributions are affected significantly by reasonable changes in data and assumptions.

Such *sensitivity analysis* will be used in this study only for the choice of discount rate and for the costs of hospital treatment, however. The effects of choosing discount rates of 2.5 and 10 per cent instead of 4 per cent will be shown for 1975. The effects of estimating the hospital treatment costs on the basis of per-patient costs instead of bed-day costs are also shown. Obviously, most other features and assumptions of the present study might have been included in the sensitivity analysis, but in many cases it is difficult to anticipate what a reasonable range of possible values may look like. Data available for use in health-economics research have always left something to be desired, and the information used in this study is certainly no exception.

I freely acknowledge that more work can be done to refine the estimates presented in this book. Such refinements would, however, need better data especially on primary care and short-term illness. While emphasizing the tentativeness of results, I still view the results as valuable first-order estimates.

Outline of the book

This book provides prevalence-based estimates of the total direct and indirect costs of illness in Sweden 1964–1975, distributed by main disease categories. This first chapter has discussed the use of cost-of-illness studies, the three different approaches that can be used, and various problems of data and estimation. The tentativeness of the results to be presented was emphasized.

Chapter 2 surveys the development of the total direct costs of the health care system 1964–1975. It also presents and examines the at-

tempts to explain the growth of total health-care consumption from the demand side, which have been made in Sweden. The effects of demographic changes and the importance of income and prices are discussed.

Explanations about the causes of the growth of the health-care sector may also be found on the supply side; slow rate of productivity growth, for instance. Chapter 3 deals with the problem of measuring changes in health-care productivity, notably public health-care productivity. Some attempts to estimate changes in public health-care productivity in Sweden will be presented.

Chapter 4 presents estimates of the distribution of total health-care costs. The direct costs of illness will be allocated by type of service (inpatient care, outpatient care, dentists, drugs, and therapeutic appliances) and by main disease category (according to WHO).

Chapter 5 provides estimates of the total indirect costs of illness in Sweden 1964–1975. Separate estimates will be presented for short-term illness, permanent disability, and premature death.

The indirect costs of illness will then be distributed as far as possible by disease categories. The results are given in Chapter 6.

Unfortunately, since the data do not permit any estimate of the distribution of the direct and indirect costs of illness for all the years concerned, we cannot do much better than finally present an estimate of the total costs, distributed by disease category for one year, 1975. The estimates and some comparisons with other available studies will be presented in Chapter 7.

Chapter 8 offers some concluding remarks.

Notes

1. *Sources:* Statistiska centralbyrån (1978 and 1980a). All the Western, industrialized economies show similar trends; see further Chapter 2.
2. For a critical review of the studies of the economic gains of early discharge from hospital, see Jönsson and Lindgren (1980).
3. See, for instance, Mushkin (1961), Schultz (1961), Weisbrod (1961b), and Becker (1962).
4. See the surveys in Dublin and Lotka (1946) and Mushkin (1961).
5. Actually, there have been some bold attempts to calculate the "psychological" costs of illness, see Abt (1975) and Mushkin (1979). Normally such costs have not been included in the cost-of-illness studies made so far.
6. For surveys of all the various areas of health-economics research, see the annotated bibliographies of English language sources edited by Culyer, Wiseman, and Walker (1977), of Western European sources, edited by Griffiths, Rigoni, Tacier, and Prescott (1980), and of Swedish sources, edited by Jönsson and Ståhl (1979).

7. Some of these cost-benefit analyses are confined to the effects on direct and indirect costs, while others also include the important aspects of pain and suffering. A thorough evaluation of the usefulness of more or less limited cost-benefit analyses is beyond the scope of the present study; see *e. g.* Jönsson (1976) instead.
8. For further examples, from the USA as well as Europe, see Culyer, Wiseman, and Walker (1977) and Griffiths, Rigoni, Tacier, and Prescott (1980).
9. For further details, see Levine and Levine (1976).
10. For a comparison between the incidence and prevalence approaches, using a simple numerical example, see Hartunian, Smart, and Thompson (1981), pp. 58–63.
11. Using the human-capital approach to determine the loss of a human life expressed in kronor seems appropriate in the present context, where the intention is to estimate the costs of illness. When doing cost-benefit analyses of different measures taken in the health and medical services, however, the human-capital approach may have to be superseded by other methods in whole or in part. One such method is the willingness-to-pay approach. The starting point for this approach, still in its infancy, is the following question: "How much would you be willing to pay at the most for a reduced risk (specified in per cent) of your dying from a certain cause?" Estimates that are made on the basis of such questions generally lead to much higher values for mortality. For a discussion of limitations to the human-capital approach regarding economic analyses of the health and medical services, see *e. g.* Schelling (1968), Mishan (1971), Jones-Lee (1976), Jönsson (1976), and Mooney (1977).
12. Much the same discussion can be found in Rice (1966) and in Hodgson and Meiners (1979). For a similar discussion on the methodology of incidence-based analyses, see Hartunian, Smart, and Thompson (1981).

2 Development of the total direct costs of the health care system 1964–1975

The direct costs of illness comprise current expenditures for prevention, detection, treatment, rehabilitation, and long-term care, due to the prevalence of diseases and conditions. This chapter is devoted to the description and analysis of the development of total health care consumption in Sweden 1964–1975.¹

Health care consumption in Sweden 1964–1975

Table 2.1 surveys the development of total health-care costs in Sweden since 1964. For practical reasons, only the costs of the institutionalized health-care system have been counted. The data come from the official national accounts, prepared by the National Central Bureau of Statistics. Using the national accounting figures facilitates comparisons with other national accounting figures such as gross domestic product and total consumption. According to Table 2.1, there has been an increase in the health care consumption of about 15 per cent a year in current prices. Correcting for inflation, using 1975 prices, the increase is 5 per cent per year for total health care consumption or slightly less, 4.4 per cent, on a per capita basis. The increase is greater than both the average increase in total consumption for all purposes and the average increase in gross domestic product, leading to increasing shares spent on health care consumption.

The growth of health care consumption in Sweden depicted in Table 2.1 is by no means unique. In fact, all the industrialised countries show similar patterns of development during the last few decades. One might say that the level of health care consumption per capita or the resources devoted to health care in a country are more or less determined by the level of national income or product of the country. This is illustrated in Figure 2.1 reproduced from Ståhl (1980), who used OECD data (OECD 1977) to calculate the health care consumption per capita for countries with varying levels of gross domestic product per capita in 1974. The Swedish health care consumption is obviously about as large as would be expected from these figures alone.

Public health care production satisfies about 85 per cent of total health care consumption. Statistically, public health care consumption (as opposed to production) takes a somewhat smaller share of total health care consumption (see Table 2.1). It should, however, be stressed that this is due to the definitions used to distinguish between private and

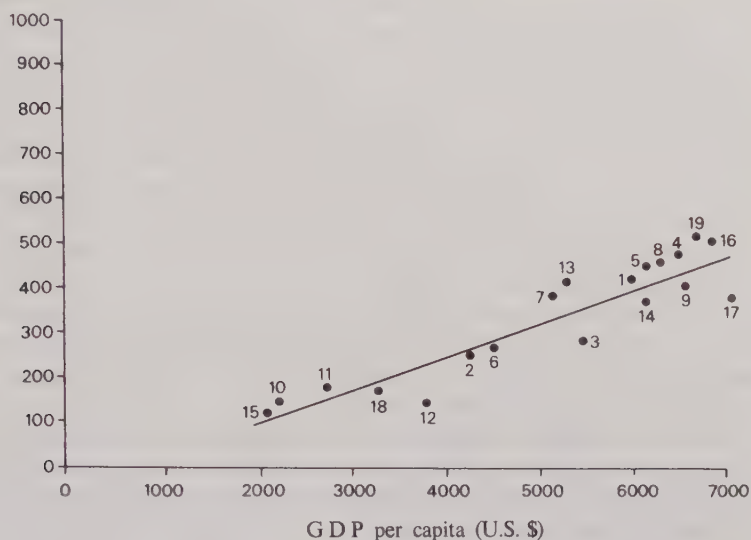
Table 2.1. Health care consumption in Sweden, 1964-1975.

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Total expenditures for health care consumption, million SEK, current prices	4,857	5,563	6,521	7,548	8,521	9,365	10,822	12,693	14,086	15,441	18,408	22,386
Total expenditures for health care consumption, million SEK, 1975 prices	13,187	13,898	14,664	16,111	17,188	18,041	18,726	19,985	20,183	20,438	21,344	22,386
Health care consumption per capita, SEK, 1975 prices	1,721	1,797	1,878	2,048	2,172	2,264	2,328	2,468	2,485	2,512	2,615	2,732
Health care consumption as percentage of total consumption, current prices	6.4	6.6	7.0	7.5	7.9	8.0	8.4	9.1	9.3	9.3	9.6	10.1
Health care consumption as percentage of gross domestic product, current prices	4.7	4.9	5.3	5.6	6.0	6.1	6.3	6.9	7.1	7.0	7.4	7.8
Public health care consumption as percentage of total expenditures for health care, current prices	67.9	68.1	70.0	70.8	70.9	71.2	73.5	75.0	75.8	74.4	75.5	76.5
Consumers' out-of-pocket expenditures as percentage of total expenditures for health care, current prices	-	-	-	-	19.7	19.3	16.9	15.7	14.8	14.4	10.8	9.4

Source: Statistiska centralbyrån (1978).

Figure 2.1. Health care consumption per capita and gross domestic product per capita in the OECD countries, 1974.

Health care consumption
per capita (U.S. \$)



1. Australia; 2. Austria; 3. Belgium; 4. Canada; 5. Denmark; 6. Finland; 7. France; 8. Germany; 9. Iceland; 10. Ireland; 11. Italy; 12. Japan; 13. Netherlands; 14. Norway; 15. Spain; 16. Sweden; 17. Switzerland; 18. United Kingdom; 19. United States.

Source: Ståhl (1980), p. 209.

public consumption in the national accounts. A certain part of the expenditures for health care consumption is considered as private consumption, even though it is supplied by the public sector. According to the System of National Accounts, "... fees, nominal or otherwise, which are charged in respect of public hospitals ..." are classed as household purchases (private consumption) of services.² This definition may in many cases seem somewhat dubious and the resulting division arbitrary.

Non-subsidized health care goods or services, for instance, over-the-counter drugs, are not a problem in this respect. They will, naturally, be included in private health care consumption. The great majority of health care services are, however, subsidized through taxes or mandatory social insurance contributions in Sweden. According to the Swedish interpretation of the System of National Accounts, the dividing line between private and public health care consumption in these cases are drawn in the following way.³ For private outpatient care, private dental care, and prescribed drugs, the whole production value is considered as private consumption even though the consumers only pay a minor part directly – the rest is paid by social insurance. For public outpatient care and public dental care, the sum of consumer charges

and social insurance payments is referred to private consumption. However, this does not cover all the expenses; the remaining parts is financed through (county) taxes and is considered as public health care consumption.

All public (and there is practically no private) inpatient care is included in the public health care consumption. In this case, there is no direct consumer charge at all. Social insurance, however, pays a nominal charge per bed day to the hospital. The remaining, and quite overwhelming, part is paid out of (county) taxes. The treatment of social insurance payments in this case is, obviously, inconsistent with that in public outpatient care or public dental care. In the latter cases, social insurance is considered to cover private consumption whereas in the first case (hospital care) it subsidizes public consumption. This clearly illustrates the arbitrariness in drawing the border lines between private and public consumption. The point is further accentuated by the fact that the social insurance payment for hospital care was earlier treated as a transfer payment to the households and, consequently, as private consumption, in earlier Swedish national accounts.

So, the interpretation of the distinction between private and public consumption may well differ between countries, making comparative studies extremely difficult. Social insurance may, for instance, be seen as part of the public sector. One way of facilitating comparisons would be to look at the share of health care expenditures which is really paid privately by the consumer.⁴ In Sweden, the share of privately paid consumption is approximately equal to the share of consumers' out-of-pocket expenditures. (Third-party payments are made either via mandatory social insurance contributions or through taxes.) The development of this share is shown in the last line of Table 2.1.

Notice the great decline in the part of the expenditures, which is paid directly out-of-pocket by the consumers. This share has decreased to such a large extent that the actual amount of out-of-pocket expenditures has decreased in real terms in spite of the great increase in health care consumption. Ten years ago about 20 per cent of the total health care expenditures was paid directly by consumers, whereas it is now about 10 per cent. Two social reforms account for the major part of this decrease. First, the out-of-pocket fees for out-patient visits to publicly employed physicians were lowered in 1970; second, a social security arrangement to pay for dental care was introduced as late as in 1974. Before 1974, most dental care was financed through consumer charges. The effects of the two reforms are easily seen in Table 2.1 as sharp declines in the out-of-pocket shares in 1970 as well as in 1974.

Table 2.1 shows the coinsurance rate, averaged across all types of health services. The rules governing the out-of-pocket expenditures differ however, quite markedly, between the services. Moreover, the rules have changed differently for different services.⁵ For *inpatient care*, for instance, the coinsurance rate has been zero during the whole period. For a visit to a *publicly employed physician* the patient paid SEK (Swedish kronor) 7 and the social insurance SEK 31 during 1970–1972. In 1973 the patient's charge was raised to SEK 12, which then was the fee

until the end of 1975. During the same period social insurance paid SEK 48 to the public provider of health care.

Until the end of 1974 the patient first paid full charge for a visit to a *private physician* and then normally got 3/4 of the charge reimbursed by social insurance. In 1975 the patient normally paid SEK 20 per visit to a private physician, but SEK 30 for a visit to a private group practice; the remaining part was paid by social insurance. This is true for the majority of physician visits, when the private physician follows the fees agreed upon in the negotiations between the Swedish National Social Insurance Board and the doctors' trade union. Some physicians, however, are not associated with the social health insurance scheme; they are free to charge the patient a higher fee, but then the patient will not get any reimbursement at all.

Children's *dental care* has been completely tax financed throughout the whole period, and 75 per cent of the costs of dental care incurred by mothers some time before and after childbirth has been covered through social insurance during the whole period. All other dental care was to be paid in total by the patient until the last quarter of 1973. During those three months the patients paid 75 per cent of the expenditures. In 1974 and 1975 the patient normally paid 50 per cent of the expenditures, but only 25 per cent if the expenditures were above SEK 1,000 or if the treatment was preventive. The remaining part was paid by social insurance.

For prescribed *drugs* the out-of-pocket charge was determined according to the following formulas. (1) For 1964–1967

$$p = 3 + 0.5(P - 3), \quad (\text{Eq. 2.1})$$

where p denotes the out-of-pocket fee and P the unsubsidized expenditures for the drugs prescribed at the same time. (2) For 1968–1975

$$\left. \begin{aligned} p &= 5 + 0.5(P - 5) \text{ if } P \leq 25 \\ p &= 15 \text{ if } P > 25 \end{aligned} \right\} \quad (\text{Eq. 2.2})$$

For *eye-glasses* the consumer normally pays the full charge (exception: eye-glasses for children). Such expenditures are not covered by social insurance in Sweden.

The actual coinsurance rates will depend not only on these rules but also on the size of the expenditures, as with drugs and dental care. The coinsurance rate for dental care is, for instance, also determined by the distribution between preventive and curative measures. The coinsurance rates for some health services can be estimated with data from the national accounts since 1968. The changes in the rules as well as in the costs have resulted in quite divergent patterns of development for the coinsurance rates of different types of health services, as can be seen in Table 2.2.

Table 2.2. Coinsurance rates for selected health services in Sweden, 1968–1975.

	1968	1969	1970	1971	1972	1973	1974	1975
Publicly provided inpatient care	0	0	0	0	0	0	0	0
Visits to private physicians	0.32	0.32	0.29	0.44	0.51	0.55	0.60	0.59
Visits to private dentists	0.98	0.98	0.98	0.98	0.98	0.95	0.48	0.36
Drugs	0.54	0.52	0.48	0.46	0.41	0.37	0.36	0.33
Eye-glasses	1	1	1	1	1	1	1	1

Source: Statistiska centralbyrån (1978).

The Swedish health care financing system

From the preceding description of the rules governing the coinsurance rates for different health services and of the distinction between private and public health care consumption it is evident that the financing of Swedish health care consumption can be divided into three groups of sources: taxes, mandatory social insurance contributions, and consumer charges. Here some additional features will be presented, starting from the national accounting data reproduced in Table 2.3.

In 1975 county taxes financed 74.7 per cent of total health care consumption; 15.9 per cent was covered by social insurance and 9.4 per cent by consumer charges. (In 1968 the corresponding percentages were 69.8, 10.5, and 19.7, respectively.)

The twenty-six county councils are by law responsible for health care delivery within their geographical boundaries. They are also empowered to impose a proportional income tax on their residents. Moreover, health care is practically the county council's sole responsibility; health care accounts for 80–85 per cent of the operating costs of a county. Inpatient care is almost completely financed through county council taxes.

Social insurance contributes relatively more to the financing of expenditures for drugs and primary care than to hospital care. The *health* insurance part of social insurance is, however, mainly a sickness cash benefit insurance. During the period 1964–1975 the sickness cash benefit payments accounted for a share of the total social health insurance expenditures between 60 and 70 per cent (Source: Riksförsäkringsverket, Allmän försäkring, various years). The Swedish social insurance is a centralised system; central government is the supreme decision-maker. Social health insurance is financed mainly by a proportional pay-roll tax; some transfer payments from central government are also involved, see Table 2.4. The Swedish social insurance scheme covers all Swedish citizens as well as foreigners resident in Sweden. Residents are automatically insured, and, in general, the insurance is compulsory.

Table 2.3. Detailed survey of health care consumption in Sweden 1975; million SEK, current prices.

Private consumption		5,251
Drugs (outside hospital)	1,901	
of which paid by		
Consumers	625	
Social insurance	1,276	
Therapeutic appliances		483
by Consumers	483	
Private physicians		428
of which paid by		
Consumers	252	
Social insurance	176	
Private dental care		1,280
of which paid by		
Consumers	466	
Social insurance	814	
Publicly employed (and salaried)		
physicians and dentists		1,159
of which paid by		
Consumers	269	
Social insurance	890	
Public consumption		17,135
Public hospitals and publicly		
employed physicians and dentists		17,135
of which paid by		
Government	16,731	
Social insurance	404	
Total health care consumption		22,386

Source: Statistiska centralbyrån (1978).

Note: The costs of visits to publicly employed physicians and dentists are referred, partly to private consumption (the part which is paid either by consumer charges or through social insurance) and partly to public consumption (the part which is paid via taxes).

Table 2.4. Sources of finance for the Swedish social health insurance in 1975, percentages.

Source	Percentage
Employers' contributions	74.2
Central government transfers	24.7
Interest, funds	1.1
Total	100 %

Source: Riksförsäkringsverket, Allmän Försäkring (1978).

The effects of demographic changes

In this and the following section some analyses of the factors underlying the growth of the health care sector will be discussed. Both demand and supply factors are relevant, but to date the latter have not been analysed as thoroughly as the former. There is some evidence, that the increasing health care expenditures cannot be explained by a faster increase in wage rates for health care personnel than for employees in other industries (Jönsson 1981). Decreases in productivity may be a factor behind the expansion of man-hours and of current-prices expenditures. Some estimates, indicating, on the whole, declines in public health care productivity, will be given in Chapter 3. The remainder of this chapter focusses on possible demand-side explanations of the growth in health care expenditures.

Dahlberg (1977) is the most ambitious attempt so far to explain the growth of health care consumption in Sweden from the demand side. The explanatory variables include population size, age-sex distribution, out-of-pocket price, sickness benefits, wages, and a time price, namely, the loss of working time in connection with the consumption of medical services. The analysis covers the period 1963–1973. First, Dahlberg analyses the impact caused by demographic changes. This is done by starting from data on the age-sex distribution of the total health care consumption in 1970 (the only available data of that kind at that time) which are reproduced in Figure 2.2. As can be expected, there are quite big differences in consumption between different demographic groups, in particular the health care consumption in the oldest age groups being considerably higher than for other groups. Since Sweden is an aging nation, the share of elderly people growing fairly fast, this might be a major factor behind the growth of health care consumption.

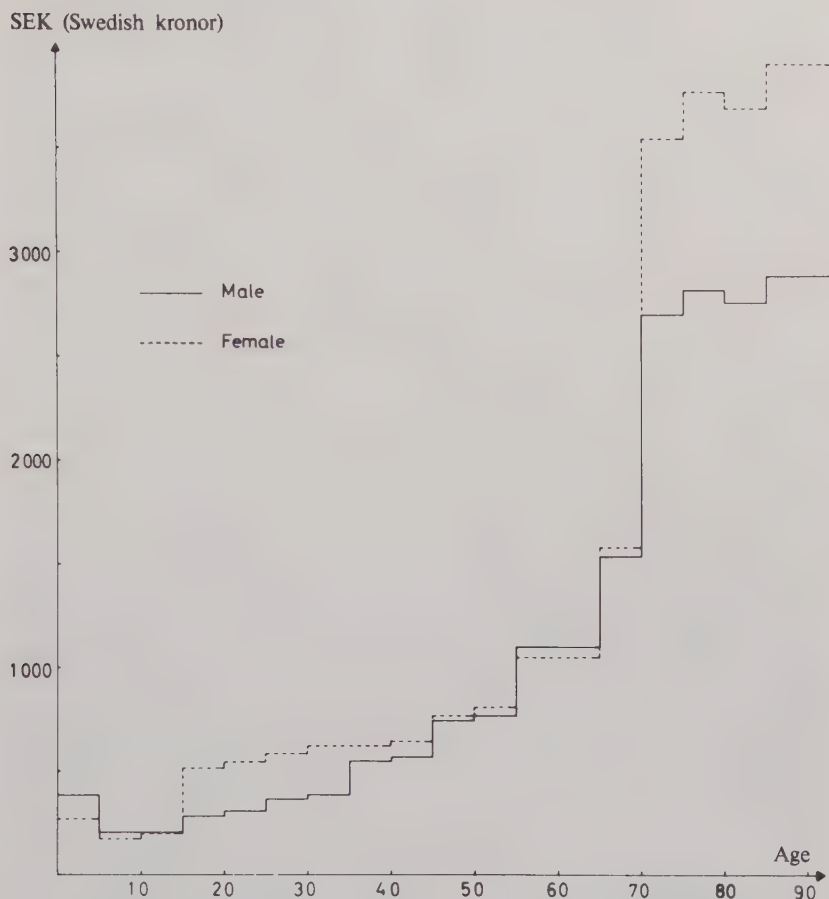
Dahlberg analyses the effects of changes in the age and sex distributions of the population as well as of changes in population size by asking the following question: "By how much would total health care consumption have risen from year to year since 1963, if every person of a certain sex and age had consumed health care services to the same production value throughout all the years as the per capita consumption for that age and sex in 1970?" This is equivalent to forming indices of the following type:

$$I_{j,k} = \frac{\sum_{i=1}^n y_{i,70} f_{ik} + \sum_{i=1}^n z_{i,70} g_{ik}}{\sum_{i=1}^n y_{i,70} f_{ij} + \sum_{i=1}^n z_{i,70} g_{ij}} \quad (\text{Eq. 2.3}),$$

where j and k , $j \neq k$, denote two of the years between 1963 and 1973; $y_{i,70}$ and $z_{i,70}$ are the consumption values for females and males, respectively, by the age i in 1970; f_{ij} (g_{ij}) and f_{ik} (g_{ik}) denote the number of females (males) by the age i in year j and year k , respectively.

Let, further, N_j and N_k denote the size of the total population in year j and k , respectively, *i.e.*

Figure 2.2. Average personal consumption for individuals of different ages and sexes in Sweden 1970 (Current prices).



Source: Dahlberg (1977), p. 4:6.

$$N_j = \sum_{i=1}^n f_{ij} + \sum_{i=1}^n g_{ij} \quad (\text{Eq. 2.4}),$$

and correspondingly for N_k .

Then the index can be divided into two parts, one showing the effect of changes in the size of population and the other showing the effects of changes in the age-sex distribution:

$$I_{jk} = \frac{N_k}{N_j} \frac{\sum_{i=1}^n y_{i,70} \frac{f_{ik}}{N_k} + \sum_{i=1}^n z_{i,70} \frac{g_{ik}}{N_k}}{\sum_{i=1}^n y_{i,70} \frac{f_{ij}}{N_j} + \sum_{i=1}^n z_{i,70} \frac{g_{ij}}{N_j}} \quad (\text{Eq. 2.5}).$$

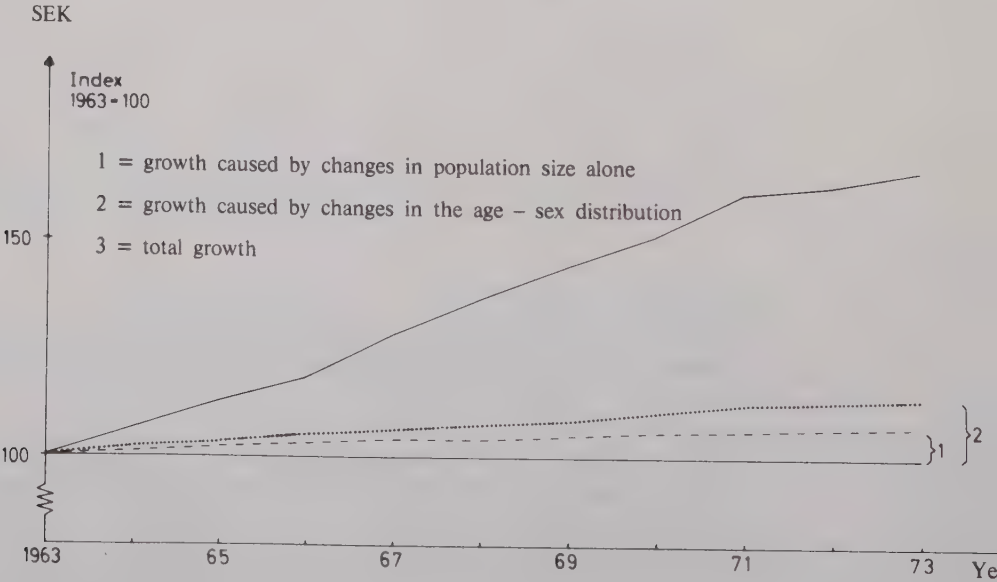
Standardizing, by letting 1963 be the base year, Dahlberg gets the results reproduced in Figure 2.3. The actual growth of health care consumption was 66 per cent from 1963 to 1973. However, only slightly more than one fifth of this growth seems to be explained by demographic changes. Moreover, according to Dahlberg's estimates, exactly 50 per cent is due to changes in the size of population alone. This means that changes in the age-sex distribution would account for only 10 per cent of the actual growth in total health care consumption. So Dahlberg concludes, that the expansion of health care expenditures in Sweden has to be explained mainly by other than demographic factors.

Jönsson (1980) comes to the same conclusion as Dahlberg regarding the period 1964–1976. Jönsson uses principally the same methodology as Dahlberg, taking age-distributed health care consumption data from 1976 and asking what became the effects on total health care consumption if the personal health care expenditures in various age groups had been the same in 1964 as they were in 1976 but the age distribution changed as it actually did.

There is, however, a slight improvement in the estimating procedure followed by Jönsson. Age-distributed data were available for different health services by which he could also allocate the effects of a changed age distribution by type of service. The results are reproduced in Table 2.5.

In the first column of Table 2.5 the effect of the changed age distribution on the consumption of various types of services is depicted. The second column reproduces the shares which the various services account for of the total health care consumption. The third column

Figure 2.3. Total growth of health care consumption and the growth caused by demographic changes in Sweden 1963–1973. Fixed prices; index 1963 = 100.



Source: Dahlberg (1977), p 4:10.

Table 2.5. The effect on total health care consumption in Sweden 1964–1976 of changes in the age distribution.

Type of service	Effect of changes in age distribution (%)	Share of total health care consumption in 1976 (%)	Effect on total health care consumption (%)
Hospital and other forms of inpatient care	11.0	57.2	6.3
Somatic care	11.3	42.9	4.8
Mental care	10.8	14.3	1.5
Services of physicians and related practitioners	0.8	23.2	0.2
Dentists	0	9.3	0
Drugs	4.6	8.2	0.4
Therapeutic appliances and other items	4.6	2.1	0.1
Total		100 %	7.0 %

Source: Jönsson (1980), p. 35.

gives the resulting partial effect on total health care consumption for each type of service, and this effect is estimated by simply multiplying for each row the percentages in the first and second columns. All in all these figures suggests, that total health care consumption would have increased by only 7 per cent between 1964 and 1976, if changes in age distribution had been the sole determinant. Since the growth of total health care consumption was 79.5 per cent during the same period of time, the changes in the age distribution of the Swedish population accounted for less than 10 per cent of that growth. (The increased size of the population accounted for approximately 10 per cent of the growth of health care consumption.)

The results regarding the influence of the changing age distribution found in the two Swedish studies are very much the same as those found for a number of countries in a study made by the OECD (1977). That study attempts to calculate the impact of the changes in age structure between 1962 and 1974 on *inpatient* costs only. The results are reproduced in Table 2.6, and they show no significant contribution from the age factor to the growth of health care expenditures.⁶

As can be seen in Table 2.5 the effects of the changes in age distribution are highly concentrated in somatic inpatient care; this type of health service is the one which is more utilized by elder people than any other service. In fact, the distribution according to age varies considerably among the health services. In Figure 2.4 the age distributions of outpatient care, inpatient care, and drugs are indicated by Lorentz curves.

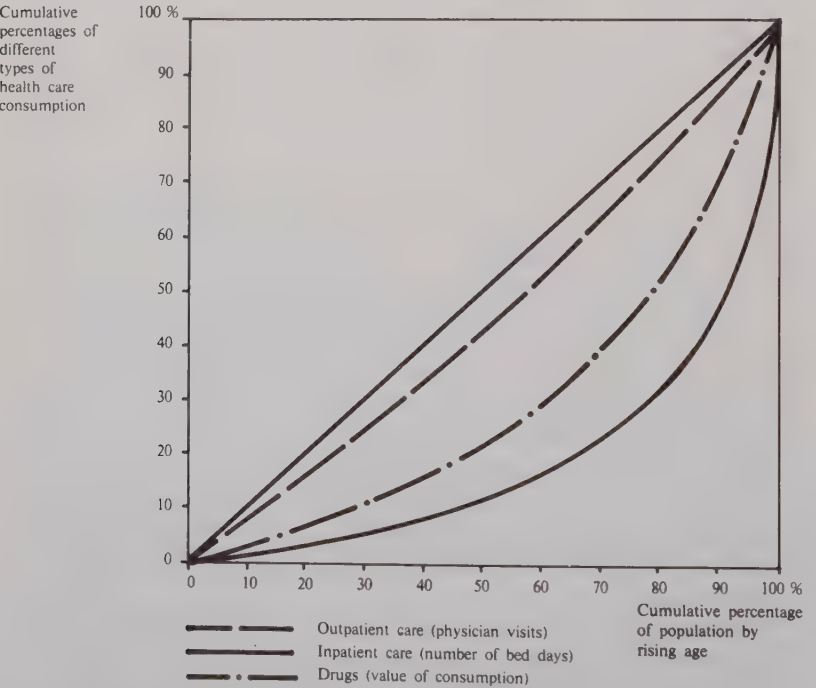
For instance, it can be seen that the youngest 90 per cent members of the population account for approximately 45 per cent of the number of bed days, which is the same as saying that the 10 per cent oldest account for 55 per cent of the bed days. So, the distribution of bed days is heavily skewed towards the older age-groups. The more skewed

Table 2.6. Changes in the shares in trend GDP of total health care expenditures and the changes in hospital expenditures due to changing age structure for a number of countries, 1962–1974.

Country	Changes in total health care expenditures as changes in shares of trend GDP, percentage points	Changes in hospital expenditures due to changing age structure, per cent of trend GDP
Australia	1.7	0.00
Austria	1.1	0.04
Belgium	0.7	0.01
Canada	1.6	0.04
Finland	1.9	0.12
France	2.2	0.04
West Germany	2.2	0.07
Italy	2.1	0.06
Netherlands	2.9	0.02
Sweden	2.6	0.19
United Kingdom	1.3	0.13
United States	2.4	0.13

Source: OECD (1977), pp. 28 and 32.

Figure 2.4. Lorentz curves showing the distributions of outpatient care, inpatient care, and drugs, according to age in Sweden 1976.



Source: Jönsson (1980), p. 21.

Table 2.7. Predicted effects on total health care consumption in Sweden 1976–2000 of expected changes in the age distribution.

Type of service	Effect of changes in age distribution (%)	Share of total health care consumption in 1976 (%)	Effect on total health care consumption (%)
Hospital and other forms of inpatient care	12.5	57.2	7.2
Somatic care	12.5	42.9	5.4
Mental care	12.4	14.3	1.8
Services of physicians and related practitioners	1.3	23.2	0.3
Dentists	0	9.3	0
Drugs	13.7	8.2	1.1
Therapeutic appliances and other items	13.7	2.1	0.3
Total		100 %	8.9 %

Source: Jönsson (1980), p. 36.

a distribution is, the greater the distance between the Lorentz curve and the diagonal line will be. In Figure 2.4 it appears that outpatient care is fairly evenly distributed, while the utilization of drugs comes somewhere between inpatient and outpatient care.

Jönsson (1980) also predicts the effects on the total health care consumption of the expected changes in the age distribution of the Swedish population until the year 2000. The predictions are reproduced in Table 2.7. For the whole period an increase in health care consumption by about 9 per cent is to be expected as the result of the changing age distribution; this is equivalent to annual increases by 0.36 per cent. Smedby (1977) and Åberg and Nordin (1977) report similar results: 0.46 per cent annually for total health care consumption and between 0.35 and 0.73 per cent for inpatient care only, respectively. Thus, the growing share of elderly *per se* does not seem to become one of the main causes of a future expansion of the health care industry.

The importance of considering the great differences in the age distributions of the health services can be illustrated with the help of a study on the distributional impact of the Swedish system of taxes and government expenditures made by Franzén, Lövgren, and Rosenberg (1976). These authors allocate all public expenditures for health care among different income groups according to the utilization of bed days in inpatient care. Not surprisingly, Franzén, Lövgren, and Rosenberg (1976) then come to the conclusion that public health care expenditures benefit low income groups. As we have seen, inpatient care is highly skewed as regards age. Persons, 65 years old and more, accounted for about 65 per cent of the bed days in somatic inpatient care in 1970, which is the year of study in this case. Furthermore, a high proportion of senior citizens have low incomes.

The Franzén, Lövgren, and Rosenberg way of allocating the public health expenditures tends to exaggerate the distributional impact for two reasons. First, inpatient care certainly accounts for about 70 per

cent of public expenditures for health care, but all other forms of health care are more evenly distributed among age groups (and, hence, probably also among income groups) than inpatient care. Second, the *number* of bed days is not a very good indicator of the benefits received, even when accepting the assumption that the value of resources used equals the benefits. The bed-day cost is substantially lower in the oldest age groups (*i.e.* in a large part of the low income groups), mainly due to the fact that a high percentage of the bed days consists of long-stay hospitalization.⁷

The importance of income and prices

In order to determine the impact of traditionally economic factors, Dahlberg (1977) follows Acton (1975) in making use of a simple consumption model concerning the (representative) consumer. It is assumed that this consumer maximizes his or her utility, U ,

$$U = U(m, X) \quad (\text{Eq. 2.6}),$$

with respect to m and X , subject to

$$(p + tw - tw_0)m + qX \leq Tw \quad (\text{Eq. 2.7}),$$

where m denotes medical services (quantity);

X is all other goods and services (quantity);

p is out-of-pocket money price per unit of medical services;

q is money price per unit of all other goods and services;

t is loss of ordinary working time per unit of medical services consumed (in hours);

T is ordinary working time (in hours);

w is earnings per hour (net of taxes); and

w_0 is sickness benefits per hour loss of ordinary working time (caused by the consumption of medical care).

The utility function (Eq. 2.6), is assumed to have usual properties concerning derivatives, *etc.*⁸

From the budget equation, (Eq. 2.7), it is immediately noted that $(p + tw - tw_0)$ may be seen as the total consumer price of medical services, while Tw is the (*ex ante*) disposable income. So changes in the total consumer price are due not only to changes in the out-of-pocket price. Evidently, the consumption of medical services is assumed to reduce working-time. This loss of earnings is, at least partly, compensated by sickness benefits. Thus, *according to the model*, the total consumer price will rise also if there is an increase in earnings per hour or in the time price, *i.e.* the loss of production time during consumption of the medical services, or if there is a decrease in the sickness benefits.

By differentiating the relevant Lagrangian expression, setting the derivatives equal to zero, *etc.*, Dahlberg's analysis comes to the following results. The quantity of medical services (m) demanded by the (representative) consumer will become larger, if there is a reduction in the

out-of-pocket price (p) or in the time price (t), or if there is an increase in the ordinary working time (T) or in the sickness benefits (w_0). A change in earnings per hour (w), however, has no unique consequence for the quantity of medical services demanded, since it creates a substitution effect, which is negative, as well as an income effect, which is positive.

The corresponding demand elasticities and the relationships between them are further developed from the model. Then these elasticities are estimated on empirical data in a rather unsophisticated way. The period of measurement is divided into five time intervals of equal length; 1963–1965, 1965–1967, 1967–1969, 1969–1971, and 1971–1973. For each interval there exists an expression, which explains at least a fraction, k, of the total variation in health care consumption left, when the effect of demographic changes has been taken into account:

$$k\left(\frac{dC}{C} - POP\right) = \eta_{mt} \frac{dt}{t} + \eta_{mp} \frac{dp}{p} + \eta_{mw} \frac{dw}{w} + \eta_{mw_0} \frac{dw_0}{w_0} + \eta_{mT} \frac{dT}{T} \quad (\text{Eq. 2.8}),$$

where C denotes total health care consumption; POP is the change in C already "explained" by demographic changes;

$\eta_{mt} = \frac{\delta m}{\delta t} \cdot \frac{t}{m}$, i.e. the elasticity of demand for medical services with respect to the time price; etc.

Not all health care demand is normally satisfied within each period of time in Sweden, incurring queues and waiting lists. Variations in the relative size of the queues would make the estimation process more difficult, since the theoretical model of the consumer determines demand, whereas the actual data are not concerned with demand but with actual consumption. In order to avoid this problem, Dahlberg boldly assumes that satisfied demand is always a certain constant fraction out of the *ex ante* demand in each period of time. The validity of this assumption is impossible to determine for lack of data on health-service queues in Sweden. Dahlberg's analysis rests, furthermore, on two additional explicit assumptions: constant consumer's preferences over time and constant rate of morbidity.

There is, however, another difficulty in translating demand into actual consumption, which is not discussed by Dahlberg. During the period of time analysed by Dahlberg, inpatient care accounted for 50–60 per cent of the health care consumption. Hospital admission cannot be attained except by the decision of a hospital physician. Therefore, one might argue that the utilization of inpatient care, i.e. the major part of health care consumption, has nothing whatsoever to do with consumers' preferences and other ingredients of the traditional model of consumer behaviour. However, it has been suggested by Arrow (1963), stressed by several authors, e.g. by Rafferty (1971), and further developed by Feldstein (1974), that the relation between the patient and

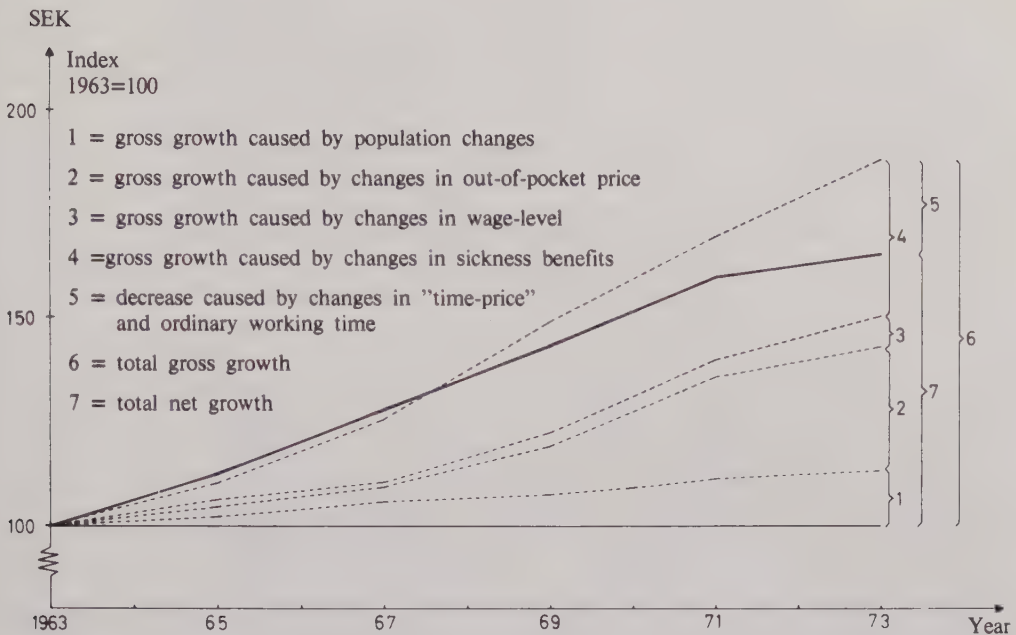
his doctor may be considered as one of agency. The patient can indicate her preferences, but then she delegates the decisions to be made to the doctor with the hope that the doctor will act for her as she would for herself if she had the appropriate technical knowledge. If the doctor acts only in the interest of his patient, *i.e.* if this agency relation is complete, it is impossible to distinguish the agency model from the traditional model as actual behaviour appears in the demand for hospital services. Though tenuous, the existence of a complete agency relation is an implicit presumption in Dahlberg's analysis. (The traditional model of consumer behaviour is easier to accept *a priori* for the rest of the health-related goods and services: physician visits, dental care, *etc.*)

Dahlberg used various data sources to calculate the change rates for $\frac{dQ}{dt}$, $\frac{dP}{P}$, *etc.* in each of the five time intervals mentioned above. For each interval there are then five unknowns (the elasticities). So by assuming both the elasticities and k to be the same in each interval, five equations with five unknowns are generated. The solution of this system of equations gives estimates of the elasticities. The estimated elasticities all satisfy expectations based on the theoretical analysis. Demand for health care is shown to be more sensitive to changes in the size of sickness benefits than in the time price, which in turn seems to have a larger impact than changes in the out-of-pocket price. The only elasticity, the sign of which was not possible to predict in the *a priori* analysis, was the one with respect to the wage rate, since a change in the wage rate had both a negative substitution effect and a positive income effect. From the empirical analysis it appears that the income effect dominated during 1963–1973 and the estimated elasticity is 0.61. A much larger response in health care demand is found from changes in the length of ordinary working time; the estimated value of this elasticity is 2.05.

By assuming that the factors included in his analysis explain all of the actual growth of health care consumption (*i.e.* assuming $k=1$ in (Eq. 2.8)) and by combining the estimated elasticities with the actual development of corresponding variables, Dahlberg is able to distribute the growth by sources of influence. The results are reproduced in Figure 2.5. The main factors behind the growth seem to be the decreases in out-of-pocket price and the increases in sickness benefits,⁹ whereas increases in the average wage rate seemingly have been of minor importance. The expansion of health care consumption due to these factors has, however, partly been counteracted by a reduction in average working time and by a slightly rising time price, according to Dahlberg's estimates.

Now, as Dahlberg also points out, the explanatory variables are not likely to explain all the growth. Dahlberg himself says that $k=0.75$ might be a more realistic value than $k=1$, but asserts that the question of choosing a value for k is totally empirical. If only time series long enough to offer a sufficient number of degrees of freedom were available, then a multiple regression analysis would answer that question (in terms of R^2 , presumably). I consider, however, the problem to be at least as much a problem of model specification.

Figure 2.5. Total growth of health care consumption and the growth caused by changes in demographic and various economic factors in Sweden 1963–1973. Fixed prices; index 1963 = 100.



Source: Dahlberg (1977), p. 4:28.

According to the model the representative consumer of health care services is a person in his productive age-range, demanding mainly inpatient care, since the consumer is supposed to lose ordinary working time during consumption of the medical services. The first question should of course be: how reliable is this picture of the representative Swedish health care consumer?

From the results published by Jönsson (1980) it is evident that persons 65 years of age or over account for about 43 per cent of total health care consumption in Sweden (in 1976). The share differs between different types of services; it is largest in inpatient care (67 per cent) and smallest in dental care (11 per cent). For persons in the productive ages loss of working time is highly associated with the use of inpatient care, but less so with the use of outpatient care and dental care (where the consumer in many cases either uses their spare time or their working time but with no deduction of earnings at all), still less in the case of drugs, and almost none when it comes to eye-glasses. So, those health services, where the time price element of the model might be of some importance, are almost entirely utilized by retired people; and for those health services, which are utilized by persons in their productive age-range, the loss of working time is more or less negligible.

Another critical point is the use of the average length of stay in inpatient care per person and year, averaged across all age groups, as a measure of the development of the time price for all health services.

This average length of stay shows a slight increase during the years studied. However, as can be seen in Table 2.8, the mean duration of stay decreased for all the productive age groups and increased only for the very old persons. These findings are consistent with the hypothesis that rising wage rates may lead to shorter hospital stays. Certainly, a positive income effect would cause people to remain in the hospital longer, but the negative substitution effect might well be so strong that most people would prefer shorter stays.¹⁰ The increase in the average length of stay for the elderly might in the same way be explained by the absence of the substitution effect. Dahlberg (1977) does not take into account unearned income other than sickness cash benefits, but in his original model, Acton (1975) uses all kinds of unearned income as an explanatory factor. It seems fairly likely that increases in the unearned income may be of some importance for that part of the population who accounts for half the health care expenditures and who rely mostly on unearned income.¹¹

So, aggregating across all age groups causes problems of estimation as well as difficulties in interpreting the results. A similar critical point could be raised against the careless use of changes in the average out-of-pocket price to explain the growth of total health care consumption. The sharp decline in the beginning of the seventies (Table 2.1) is not due to a uniform increase in the subsidy of all types of medical services but mainly the effect of lowering direct consumer charges in publicly provided outpatient care (Table 2.2). *"An empirically very significant problem occurs if expenditures on medical services having different kinds of insurance coverage are aggregated and a coinsurance rate averaged across the services is used to explain demand"*. (Newhouse *et al.* 1980, p. 377.)

Table 2.8. Bed days per capita and year in various age groups; inpatient somatic and mental care, respectively, 1964 and 1976.

Age	Somatic care		Mental care	
	1964	1976	1964	1976
0 - 4	1.2	2.9	0	0
5 - 14	0.5	0.3	0	0
15 - 24	1.1	0.6	0.4	0.3
25 - 34	1.2	0.6	0.9	0.7
35 - 44	1.3	0.9	1.3	0.9
45 - 54	1.9	1.4	1.8	1.1
55 - 64	2.8	2.4	2.5	1.6
65 - 69	4.8	4.0	3.1	3.0
70 - w	10.9	14.2	4.8	8.2
All ages	2.4	2.5	1.3	1.3

Sources: Socialstyrelsen, Patientstatistik, various years (for somatic care) and Socialstyrelsen, Sluten psykiatrisk lasarettsvård, various years (for mental care).

Note: Data on the number of bed days in mental care are not available for the age group 65-69. Instead, for the two last lines of the table the age groups are 65-74 and 75-w, respectively, as regards mental care.

The structure underlying the observed data and to be estimated is only identical in all periods if the price elasticities of the services are equal or if the relative out-of-pocket prices are constant.¹² There are no estimates of price elasticities available for Sweden, but, according to American estimations, price elasticities of health services do differ.¹³ The relative out-of-pocket prices are obviously not stable. The coinsurance rates of various health services develop quite differently (Table 2.2).

Furthermore, using a mis-specified aggregated model instead of a correctly specified disaggregated model may well result in quite non-sensical estimates. A simple example may clarify this point. Suppose, that the following aggregated model is estimated

$$q = a + bp + u \quad (\text{Eq. 2.9}),$$

where q denotes the total amount of the health services (the units are specified in such a way that the cost of producing the unit is equal to one), p is the average out-of-pocket price, u is an error term, and a and b are constants. The true relationships are, however,

$$q_1 = a_1 + c_1 t_1 + u_1 \quad (\text{Eq. 2.10})$$

for inpatient care and

$$q_2 = a_2 + u_2 \quad (\text{Eq. 2.11})$$

for outpatient care.

The notation is equivalent to that used above; t_1 is some factor influencing positively the quantity of hospital care demanded. For a number of years, say the years 1, . . . , 10, no changes in p_1 , p_2 and t_1 occur, while from the eleventh year onward, say until year 20, p_2 is lowered and t_1 increases.

So, with the exception of the systematic influence of the rise in costs due to the increase in t_1 , expenditures are *in fact* random.

The mis-specification of the model then would result in estimates of the price elasticity which were nonsensical. The true price elasticity is zero, but estimation of the mis-specified model would yield the "expected" negative value.

Suppose, for instance, that a hospital expenditure in Sweden costs on average SEK 10,000 per year, if it occurs in one of the first ten years, and SEK 12,000 in the following ten years. The total population is 8 million people, and the 20 per cent of the population who are hospitalized uses on average SEK 2,000 worth of outpatient care. The other 80 per cent of the population uses on average SEK 500 of outpatient care. Total health care expenditures will then become SEK 22,400 million for the first ten years and SEK 25,600 million thereafter.

Suppose, further, that the expenditures for inpatient care are covered completely for all individuals by way of county council taxes, as they are in Sweden. The coinsurance rate for outpatient care is 50 per cent during the first ten years and 25 per cent thereafter. The coinsurance

Table 2.9. Physician visits in publicly provided outpatient care, 1964-1975.

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	Average percent- age change, 1964- 1970	Average percent- age change, 1970- 1975	Average percent- age change, 1964- 1975
Number of visits in general hospitals, thousands	6,214	6,577	6,872	7,177	7,683	8,351	8,822	9,200	9,293	9,422	9,724	10,053	-	-	-
Number of visits in other forms of publicly provided outpatient care, thousands	1,031	1,237	1,301	1,231	1,253	947	5,586	6,470	6,266	6,238	6,691	6,665	-	-	-
Total number of visits in publicly provided outpatient care, thousands	7,425	7,814	8,173	8,408	8,936	9,298	14,408	15,670	15,559	15,660	16,415	16,718	-	-	-
Percentage change in the number of total visits in general hospitals since previous year	5.2	5.8	4.5	4.4	7.0	8.7	5.6	4.3	1.0	1.4	3.2	3.4	6.0	2.6	4.5
Percentage change in the number of total visits in publicly provided outpatient care since previous year	1.9	5.2	4.6	2.9	6.3	4.0	3.0	8.8	-0.01	0.01	4.8	1.8	4.3	3.0	-

Source: Socialstyrelsen, Allmän hälso- och sjukvård, various years.

Note: Visits to district medical officers are not included until 1970. They are excluded, however, from the 1970 figures in the comparisons of yearly changes 1964-1970.

rate averaged across the two kinds of health services will then become 0.143 for the first ten years and 0.063 for the following ten years. Regressing total health care expenditures linearly on this average out-of-pocket price gives an estimated price elasticity of -0.25 ; the true price elasticity is zero.

Besides, if it were true after all, that the lowering of the out-of-pocket charge for publicly provided outpatient care can explain the observed increase in Swedish health care consumption, we would expect the effect to be most marked in outpatient care. The empirical evidence, however, does not give very much support for this hypothesis. From data published by the Swedish National Board of Health and Welfare and reproduced in Table 2.9 it can be seen that the annual rate of growth of physician visits is, actually, smaller after 1970 than before 1970. Now, it may still be true that the lowering of the coinsurance rate did increase *demand*, as opposed to satisfied consumption. There is some evidence of markedly increased length of queues for non-acute outpatient care in 1970 and 1971,¹⁴ but the possibility of demand rising faster than satisfied consumption was ruled out from Dahlberg's analysis *ex definitione*.¹⁵

So, even though Dahlberg (1977) seems to be the most ambitious attempt to explain the factors underlying the growth of health care consumption, there are several weaknesses in the analysis and difficulties in interpreting the results because of the problems of aggregation. Other attempts have concentrated on simple linear regressions, where health care consumption is the dependent variable and gross domestic product is the only explanatory variable. These regressions normally perform well, the growth of GDP explaining almost all the growth of health care consumption; see, for instance, Table 2.10, reproduced from Jönsson (1979). The estimated income elasticity is larger than one but decreases seemingly with the passage of time. The decline is not statistically significant, however (95 per cent confidence intervals overlap). Naturally, these simple regressions are subject to the same criticisms as those levelled at Dahlberg's study; moreover, in the simple regressions important explanatory variables are left out.

Evidence of the importance of income as an explanatory factor may also be found in cross-section analyses. Granqvist and Håkansson (1978) show that the differences in health care consumption between the Swedish counties in 1973 are mainly explained by differences in per capita income of the counties. Similarly, the differences in GDP per capita explain about 85 per cent of the variation in the health care consumption per capita among the OECD countries in 1974; see Table 2.2. The estimated income elasticity is 1.2 (Ståhl 1980).

Table 2.10. The elasticity of health care consumption with respect to gross domestic product in Sweden, 1975 prices.

Period	Elasticity	Standard deviation	Correlation coefficient
1963/72	1.65	0.09	0.98
1964/73	1.68	0.10	0.97
1965/74	1.56	0.11	0.96
1966/75	1.48	0.10	0.96
1967/76	1.45	0.11	0.96

Source: Jönsson (1979), p. 59.

Summary and concluding remarks

From 1964 to 1975 the Swedish health care consumption rose by an average annual rate of five per cent in 1975 prices, increasing its share of the gross domestic product from 4.7 per cent to 7.8 per cent.

Various factors explaining the growth have been discussed.¹⁶ About 10 per cent of the growth seems to be attributable to the increase in population size and another 10 per cent to changes in the age distribution. From simple linear regression analyses income seems to be the all-important explanatory factor. To some extent this finding can be explained by very stable trends in both national income and health care consumption. There are, however, similar trends in other factors which may cause changes in the health care consumption, *e.g.* changes in out-of-pocket charges and sickness cash benefits. Since these changes affect the health services differently, one cannot rely on estimates based on too aggregated a model.

An econometric model of the health care sector, comprising *inter alia*, different demand equations for inpatient care, for outpatient care, for drugs, *etc.*, and different demand equations for elderly people and young people, seems relevant as a tool for analysis of the past and for predictions of the future. Such econometric models have been developed for the USA, see, for instance, Yett *et al.* (1979). However, the data required are not readily available. In fact, to estimate the various statistical components is an important and demanding task *per se*. Some estimates of the changing contents of health care consumption in Sweden will be given in Chapter 4. In the next chapter, however, the development of public health care productivity will be discussed.

Notes

1. The reasons for starting at 1964 and ending at 1975 were given in Chapter 1.
2. Cf. United Nations (1968), p. 105.
3. Cf. Statistiska centralbyrån (1980b), pp. 46–47.
4. In the most recently published national accounting data for Sweden (Statistiska centralbyrån, 1980a), the border line drawn between private and public consumption has been moved in this direction.
5. The information on these rules used in the following description comes from Riksförsäkringsverket, Allmän försäkring, various years.
6. The same empirical evidence can be found in a cross-section study of those factors which explain the differences in health-care costs between the 26 counties of Sweden in 1973 (Granqvist and Håkansson 1978). The share of persons, 70 years old or more, does not seem to have any major impact on the average number of bed days per capita, nor on the hospital costs per bed day in the counties.
7. There are other weaknesses in the estimating procedure as well. Above all, the income concept used, *i.e.* total net income in a certain year, tends to overemphasize the effects of public expenditures provided to persons with temporarily low incomes, for instance, because of sickness or high age. If life time income had been used instead, the permanent low income earner could have been in the focus of analysis; *cf.* Lindgren and Söderström (1979). For an application of this lifetime-income approach, see Layard (1977). There the lifetime approach is applied to various educational policy options in Britain.
8. Thus, the utility function is assumed to be quasiconcave, continuous with continuous derivatives and with positive marginal utilities, characterized by $U_{XX} < 0$, $U_{mm} < 0$, $U_{Xm} > 0$, and $U_{mX} > 0$, where

$$U_{XX} = \frac{\partial^2 U}{\partial X^2} \text{ etc.}$$
9. The one major improvement in sickness cash benefits was the shortening of the waiting period in 1967. Before 1967 the waiting period before sickness cash benefits start to be payable was three days. From 1967 the waiting period is only one day.
10. These results are similar to those found by Holtman (1972). Cross-section data for the USA were used, and they showed a decreasing average length of stay with rising income for non-retired people.
11. At least as long as one uses a one-period model of consumer behaviour, the unearned income of the elderly may be a factor of great importance. (Estimates based on life-cycle models of consumer behaviour might further add to our knowledge of health care demand.)
12. See Theil (1954) and Newhouse *et al.* (1980).

13. See, for example, Phelps and Newhouse (1974).
14. See Gabriellii and Serner (1971) and Johansson and Serner (1972).
15. One of the main reasons why public health care did not respond to the increased demand with markedly increased supply may be found in the fact that the remuneration of publicly employed physicians changed from a fee-for-service to a salary system, also in 1970. Even though Gabriellii and Serner (1971) and Johansson and Serner (1972) deny it, this may well have led to decreased physician productivity.
16. Explanations based on a presumed "uniqueness" of the Swedish health care system have been deliberately excluded. There seems to be no evidence of a quite specific performance of the Swedish system. On the contrary, seemingly quite different health care systems produce rather similar results regarding total health care consumption; see, for instance, OECD (1977). The various contributions by political scientists that can be found in the recently published conference volume, *The Shaping of the Swedish Health System*, ed. by Heidenheimer and Elvander (1980), do not seem to provide any other valid conclusions, either.

3 Some estimates of changes in public health care productivity in Sweden

Data from the official Swedish national accounts were used in the description and analysis of the development of health care consumption in Chapter 2. About 85 per cent of total health care consumption is satisfied by *public* health care production. The development of public health care consumption and production, as shown in the national accounts, is, however, based on the assumption that no changes in productivity take place over time. *Ex definitione*, there is no possible way of raising public health care production without at the same time increasing the use of labour or other factors of production. On the other hand, no decline in production may be observed, unless factor use has been decreased. This assumption of zero productivity change is made for all branches of the public sector and in accordance with internationally recommended principles. Moreover, it is also assumed in the national accounts that the production value of the public sector is always exactly equal to its costs of production. Behind these assumptions there is the notion that it is difficult to say what is produced in the public sector and to measure that production in physical terms.

A growing share of the total resources of the Swedish economy is devoted to the provision of services financed by taxes. The public sector in Sweden increased its share of total employment, for instance, from 15 per cent in 1964 to 25 per cent in 1975, a fairly large increase during slightly more than a decade. Considering that the measure of total output will rely on *a priori* postulates of production value and productivity change for a growing part of total employment, there is, obviously, a great risk that the data on national income, gross domestic product, rate of growth of GDP, *etc.* may become increasingly unreliable.

The *a priori* postulates not only affect the reliability of the aggregate data on national income and product but also make the evaluation of various parts of the public sector extremely difficult. This chapter is concerned with the problems of measurement of changes in the productivity of public health and medical care. In the past, some suggestions have been put forward on how to improve the fixed prices calculations in the national accounts, but these proposals have generally been based on various very rough estimates. The relevance of such rough estimates will be discussed first. Then this chapter will provide an account of possible approaches to the estimation of health care productivity.

Background

In Table 3.1 some national accounting data on production and employment within public health care are reproduced.¹ There it appears, that public health care increased its contribution to gross domestic product, GDP, at market prices from 2.4 per cent to 5.0 per cent in current prices and from 3.7 per cent to 5.0 per cent in fixed (*i.e.* 1975) prices between 1964 and 1975. During the same period public health care increased its share of the total number of employed people (and the total number of working hours, respectively) from 3.8 per cent (3.7 per cent) to 7.2 per cent (6.7 per cent). According to the national accounts value added per hour within public health care increased from SEK 31.85 to SEK 35.02 (in 1975 prices), *i.e.* by 10.0 per cent for the whole period 1964–1975 or by about 0.9 per cent a year. At the same time, however, the number of working hours per person decreased to such an extent that value added per person employed within public health care diminished from SEK 54,518 to SEK 49,155 (in 1975 prices).

There are, however, some good reasons why these figures on value added or on the changes in value added per hour or person should be questioned. Formally, the production of all goods and services is treated identically in the national accounts. Value added (v) is given by:

$$v = \sum_{i=1}^m p_i x_i - \sum_{j=1}^n q_j y_j \quad (\text{Eq. 3.1}),$$

where p_i and q_j are, respectively, prices of outputs and inputs, and x_i and y_j , respectively, are quantities of outputs and inputs. Value added can further be divided into wages and operating surplus. If value added has been corrected for the extent to which capital is depreciated through use in production, net value added is obtained. Gross value added, on the other hand, makes no allowance for capital consumption.

The construction of estimates of health care production is subject to the difficulty that there is no direct information on p_i or $p_i x_i$ and very limited information on x_i . Public health care is provided at heavily subsidized prices and demand is never completely satisfied, so it would be nonsensical to use consumer charges in order to determine value added.

In the product accounts of the private sector, the operating surplus is a residual. For public health care and every other part of the public sector on the other hand, net operating surplus is assumed *a priori* to be zero. Gross value added, v , then becomes equal to the sum of wages and capital consumption. As far as inputs are concerned, both q_j and y_j ($j=1, \dots, n$) are known. By adding $\sum_{j=1}^n q_j y_j$ to the sum of wages and capital consumption, the value of output, the production value $\sum_{i=1}^m p_i x_i$, will be obtained. This estimating procedure is not unique to Sweden. On the contrary, it strictly conforms to the principles which the United Nations recommend its Member countries to follow.²

The assumption of zero operating surplus may not be preposterous.

Table 3.1. Public health care in Sweden, 1964–1975. Value added, employment, and "productivity".

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Value added, million SEK, current prices	2,505	2,872	3,439	4,035	4,623	5,271	6,487	7,701	8,878	9,827	11,783	14,481
Value added, million SEK, 1975 prices	7,747	8,075	8,361	9,357	10,112	10,868	11,883	12,707	13,232	13,378	13,867	14,481
Employment, number of persons	142,100	148,500	155,500	168,200	182,000	198,500	215,400	240,200	256,700	263,000	280,400	294,600
Employment, million of hours worked	243.21	252.40	260.26	275.41	293.73	314.73	342.67	366.29	378.13	383.47	393.76	413.45
Value added in 1975 prices per person	54,518	54,377	53,768	55,630	55,560	54,751	55,167	52,902	51,547	50,867	49,454	49,155
Value added in 1975 prices per hour	31.85	31.99	32.13	33.97	34.43	34.53	34.68	34.69	34.99	34.89	34.95	35.02
Value added as percentage of GDP, current prices	2.4	2.5	2.8	3.0	3.3	3.4	3.8	4.2	4.5	4.5	4.7	5.0
Value added as percentage of GDP, 1975 prices	3.7	3.7	3.8	4.1	4.2	4.4	4.5	4.9	5.0	4.9	4.9	5.0
Employment as percentage of total employment, number of persons	3.8	3.9	4.1	4.5	4.8	5.2	5.5	6.1	6.5	6.7	7.0	7.2
Employment as percentage of total employment, hours worked	3.7	3.8	3.9	4.3	4.6	4.9	5.3	5.8	6.1	6.3	6.4	6.7

Source: Statistiska centralbyrån (1978).

There are good reasons for the belief that heads of departments and other decision makers of the publicly financed hospitals have not always been particularly concerned to make a surplus. The profit motive has, for instance, been regarded as irrelevant or inappropriate from general, social or political, points of view. This is, however, an attitude which now has begun to change. In certain hospital departments new programme planning and budgeting systems are tested. An important characteristic of these systems is the creation of incentives for the head as well as for the staff of the department to minimize the costs for a given level of production.

In the treatment of the operating surplus there is, however, an implicit value judgement saying that health care is worth at least as much as the resources there used and consumed. But since there is no market for the purchase and sale of public health services, the consumer cannot reveal her preferences through her behaviour in the market. So it is impossible to know whether consumers really consider health care services to be worth their cost of production. The value of health care output, as it appears in the national accounts, is as likely to be an overestimate as it is to be an underestimate, compared with the hypothetical market solution. A negative operating surplus may then, hypothetically, be as likely as a positive one.

Even though it might be reasonable to measure output *value* in public health care on the basis of the *value* of inputs and the productive factors, labour and capital, it seems, however, inappropriate to use the *volume* of inputs or productive factors in order to estimate output *volume*. (The same goes for prices of inputs, factors of production, and output as well.) In physical terms, outputs are not the same as inputs. Consequently, they are, at least principally, expressed in different units of volume, which may change quite differently over time. This means that estimates of the development of health care production in real terms are even more difficult to make than those of the value of output in current prices.

The changes in real value added in public health care in Sweden which were noted previously, were calculated on the assumption of zero operating surplus. Furthermore, the fixed prices calculation has been made separately for each kind of cost, without there being any correction for the fact that the combination of the factors of production might have become more or less productive over time. This estimating procedure, too, is in accordance with internationally recommended principles and common practice. The value added or the production value per employee or per hour worked within public health care, as they appear in the national accounts, will, therefore, be affected only by shifts in the shares of different types of costs. Such a change will, however, give no information on if or how the productivity has changed in reality. The "productivity increment", to which was referred above and which was also presented in Table 3.1, is, thus, nothing more than a statistical artifact.

Comparison with private health care in Sweden

In the discussion on the possible improvements of the measure of production in public services which has been going on for many years between national accountants, statisticians, and economists, there have been suggestions that changes in productivity for labour and for capital may be imputed on the basis of corresponding estimates for those parts of the economy where productivity or changes in productivity are easier to measure. At first sight it seems fairly obvious that private health care in Sweden should serve as the primary basis for such a comparison.

The estimates of private health care production are based on data on social insurance expenditures for private care. As can be seen in Table 3.2, the contribution of private health care to GDP in 1975 prices was 0.9 per cent in 1964 and 0.6 per cent in 1975. Of the total number of entrepreneurs and employees, private health care accounted for 0.7 per cent in 1964 and 0.8 per cent in 1975, while it increased its share of the total number of hours worked from 0.6 per cent to 0.7 per cent between 1964 and 1975. Value added per person decreased from SEK (Swedish kronor) 72,500 to SEK 56,770 (in 1975 prices) from 1964 to 1975. During the same period of time, value added per hour went down from SEK 44.48 to SEK 39.12 (in 1975 prices).

Value added per hour seems to decline by 12 per cent between 1964 and 1975, *i.e.* about 1.2 per cent per year in private health care. However, it can also be seen in Table 3.2 that there is a rising trend in the value added per hour in 1975 prices since 1964 which is abruptly broken in 1970. Between 1964 and 1969 the growth of private health care productivity averages 4.3 per cent a year. Then there seems to be a sharp decline in productivity between 1969 and 1970. However, between 1970 and 1975 private health care increases its value added per hour by an average of 1.4 per cent a year.

The registered fall in private health care productivity in 1970 may be explained by the new forms of work contracts starting in 1970. Before 1970 publicly employed doctors served partly as private physicians in the hospitals' outpatient departments. Hospital doctors also had the right to have private patients of their own. These two things disappear in 1970, and so the value added of private health care shows a marked decline in that year, whereas at the same time public health care shows a corresponding increase. Considering the difficulties in getting reliable employment data for the previously private activity within the institutionally public sector, there are good reasons for the assumption that the size of private health care employment before 1970 to some extent is underestimated.

Thus, since there are, obviously, sources of errors also in the private health care statistics, the registered development of productivity should be interpreted with extreme caution. This is one reason why changes in private health care productivity cannot be directly used as approximate estimates of public health care productivity. A further reason is that the services provided in private and public health care differ to a large extent. Almost all more important surgical procedures are, for instance, performed in hospitals, financed by county (or, to a certain degree,

Table 3.2. Private health care in Sweden, 1964-1975. Value added, employment, and "productivity".

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Value added, million SEK, current prices	742	829	915	1,057	1,218	1,304	1,120	1,201	1,292	1,359	1,519	1,828
Value added, million SEK, 1975 prices	1,914	1,950	1,970	2,021	2,104	2,151	1,459	1,458	1,502	1,520	1,667	1,828
Employment, number of entrepreneurs and employees	26,400	26,400	26,000	25,800	26,200	26,300	26,800	26,200	28,700	29,100	29,600	32,200
Employment, million of hours worked	43.03	42.54	40.75	39.65	39.51	39.15	40.02	38.57	41.16	40.87	45.49	46.73
Value added in 1975 prices per person	72.500	73.864	75.769	78.333	80.305	81.787	54.440	55.649	52.334	52.234	56.318	56.770
Value added in 1975 prices per hour	44.48	45.84	48.34	50.97	53.25	54.94	36.46	37.80	36.49	37.19	36.65	39.12
Value added as percentage of GDP, current prices	0.7	0.7	0.7	0.8	0.9	0.8	0.7	0.7	0.7	0.6	0.6	0.6
Value added as percentage of GDP, 1975 prices	0.9	0.9	0.9	0.9	0.9	0.9	0.6	0.6	0.6	0.6	0.6	0.6
Employment as percentage of total employment, number of persons	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8
Employment as percentage of total employment, hours worked	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7

Source: Statistiska centralbyrån (1978).

state) taxes. The development of productivity in surgery will only by mere coincidence be the same as in the kind of outpatient care which is typical for private health care.

Comparison with health care in the USA

An alternative way to measure Swedish public health care productivity would be to base the estimates on data on productivity changes in countries with mainly privately financed health care. Then the composition of health care production might be more alike than in the former case where the comparison was made with private health care within Sweden. New kinds of dissimilarities will, however, certainly be introduced, affecting the plausibility of the approximation. A direct transfer of the officially presented data on productivity changes in private health care in the USA would generate similar results to the assumption of constant productivity currently used in Sweden at least as far as the period after World War II is concerned. This can be seen in Table 3.3.

The development of productivity which is reproduced in Table 3.3 is based on a fixed prices calculation of US health care, which in its turn is based on the official American price index for health care, calculated by the Bureau of Labor Statistics (BLS).³ This price index includes the charges for a physician visit at home, for a visit to the physician's office, for a certain surgical treatment, for one bed day, for drugs *etc.* Changes in the prices of these goods and services affect the price index. Changes in medical technology, however, are not reflected in the index.

The cost of a given treatment will become higher, if the number of laboratory tests is increased. The cost will go down, if the length of hospital stay is shortened. This will, however, not have any effect on the BLS index, since it is the price of a certain test or the price of a bed day and not the price or cost of the whole treatment which is reckoned there. A reduction of the duration of hospital stay cannot, therefore, give rise to a decline in the BLS index. On the contrary, the index would probably increase, since the charge for each bed day would have to be raised due to the fact that a patient often requires

Table 3.3. Productivity changes in health care production in the USA 1929–1965.

	1929– 1965	1929– 1947	1947– 1965	1947– 1956	1956– 1965
Yearly change in productivity, percentages	0.9	1.9	–0.3	–1.3	0.6

Source: Fuchs (1968).

more attention and help in the beginning than at the end of a hospital stay. This is an unsatisfactory feature of the BLS index.

As an alternative to the BLS health care price index, it was suggested by Anne A. Scitovsky (1964) that an index based on the treatment costs of different diseases might be formulated and estimated. Scitovsky (1967) compared the BLS index with the development of the cost of treatment for selected diseases at the Palo Alto Medical Clinic in California. Scitovsky found that the costs of treatment for all the five diseases included in the study rose by more (for some diseases considerably more) than the BLS health care index. Therefore, the results from this study indicate that the development of productivity within the health care system might be *overestimated* in the official figures. It also implies that great care should be taken before transferring the American development of health care productivity directly into the Swedish national accounting figures on health care.

Constant yearly change in productivity

A similar method of obtaining a measure of Swedish health care productivity assumes a constant yearly change in productivity. (The assumption of zero change in productivity which is used in Sweden is naturally in itself just a special case of a general *a priori* assumption of a constant yearly change in productivity.) In this approach it is asserted, for example on the basis of private service production in general, that it seems reasonable to believe that the productivity within the public sector increases by, say 3 per cent, every year.⁴ With an assumption of a yearly increase in productivity by three per cent, the contribution of public health care to GDP in 1975 prices would grow significantly from 3.0 per cent in 1964 to 5.0 per cent in 1975. A decline in productivity, averaging two per cent a year, would, on the other hand, leave the percentage contribution fairly unchanged throughout the period, *i.e.* about five per cent. The calculations behind these estimates are found in Table 3.4.⁵

In Table 3.4 column 1 shows the percentage changes from year to year between 1964 and 1975 for the value added in current prices of public health care in Sweden. The difference between the changes in value added in current prices and in 1975 prices (column 2) gives the price index development used in the national accounts and reproduced here in column 4. The difference between the changes in value added in 1975 prices and the changes in employment (column 3) gives the development of productivity as it appears in the national accounts (column 5). It can be seen that the productivity growth of public health services seems to be approximately zero. How the price index of the public services changes from one year to another, if the assumption of exactly zero growth of productivity is shown in column 6. With an assumption of 3 per cent growth of productivity the price index will rise more slowly (column 7) and the value added more quickly (column 8). Columns 9 and 10 assume 2 per cent decline in productivity.

Table 3.4. The effects on the development of the value added of public health care in Sweden by different assumptions on productivity. Percentage change since previous year.

Year	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Value added, current prices	Value added, 1975 prices	Employment, hours of work	"Price index" according to the national accounts	"Productivity" according to the national accounts	"Price index" if zero growth of productivity	"Price index" if 3 % growth of productivity	Value added, 1975 prices if 3 % growth of productivity	"Price index" if -2 % growth of productivity	Value added, 1975 prices if -2 % growth of productivity
						[=(1)-(3)]	[=(1)-(3)]	[=(1)-(7)]		[=(1)-(9)]
1964	12.3	3.8	3.9	8.5	-0.1	8.4	5.4	6.9	10.4	1.9
1965	14.6	4.2	3.8	10.4	0.4	10.8	7.8	6.8	12.8	1.8
1966	19.7	3.5	3.1	16.2	0.4	16.6	13.6	6.1	18.6	1.1
1967	17.3	11.9	5.8	5.4	6.1	11.5	8.5	8.8	13.5	3.8
1968	14.6	8.1	6.6	6.5	1.5	8.0	5.0	9.6	10.0	4.6
1969	14.0	7.5	7.1	6.5	0.4	6.9	3.9	10.1	8.9	5.1
1970	23.1	9.3	8.9	13.8	0.4	14.2	11.2	11.9	16.2	6.9
1971	18.7	6.9	6.9	11.8	0	11.8	8.8	9.9	13.8	4.9
1972	15.3	4.1	3.2	11.2	0.9	12.1	9.1	6.2	14.1	1.2
1973	10.7	1.1	1.4	9.6	-0.3	9.3	6.3	4.4	11.3	-0.6
1974	19.9	3.7	2.7	16.2	1.0	17.2	14.2	5.7	19.2	0.7
1975	22.9	4.4	5.0	18.5	-0.6	17.9	14.9	8.0	19.9	3.0

There is, however, no particular reason to believe that the productivity of the public health care system is increasing over time by a certain constant rate of change. Investments in real capital may certainly raise labour productivity within health care as well as in other sectors of the economy. Technical progress resulting in new methods of treatment often with the help of new capital equipment and/or new drugs may be even more important. New investments as well as innovations are presumably fairly irregular elements in the changing production patterns of health care. According to the national accounts, the gross investments in public health care developed in the way, shown in Table 3.5 between 1964 and 1975.

An important additional potential source of productivity fluctuations is changes in demand conditions. Such changes will influence the health care utilization rate in any given year, which, clearly, may affect the *actual* productivity of the health care system. Such demand factors are, *e.g.*, changes in the age structure of the population and the rare occurrence of widespread epidemics. Clearly, constant productivity growth is unlikely to result from demand-side disturbances.

Thus, the assumption of a certain constant yearly rate of change is not a quite satisfactory approximation to the real world. The importance of the assumption differs, however, depending on the nature of the analysis. Whilst short-term changes in productivity are not reflected in this approach, for longer-term analyses yearly variations are of no importance. Were good estimates of the rate of change for longer periods of time obtainable, much would be gained. Unfortunately, such estimates are currently unavailable. Consequently, there is no logical basis for determining the appropriate level of the constant rate of growth of productivity.

Table 3.5. Gross investments in public health care in Sweden, 1964–1975. Million SEK, 1975 prices.

	1964	1965	1966	1967	1968	1969
Gross investments, million SEK, 1975 prices	1,062	1,246	1,437	1,730	2,205	2,221
Percentage change since previous year	14.6	17.3	15.3	20.4	27.5	0.7
	1970	1971	1972	1973	1974	1975
Gross investments, million SEK, 1975 prices	2,426	2,161	1,981	1,784	1,603	1,801
Percentage change since previous year	9.2	-10.9	-8.3	-9.9	-10.1	12.3

Source: Statistiska centralbyrån (1978).

Development of real production in inpatient somatic care 1964–1976

The direct transfer of measures of productivity change from private medical care (within Sweden or from abroad) or from private services in general is inappropriate. Private and public medical care may mean quite different services; surgery, for instance, is almost exclusively performed in tax-financed hospitals in Sweden. Further, measures of private sector output are frequently not much better than those for the public sector. So, finally, there is actually no firm ground for a choice of a certain rate of productivity change which could be imputed to the public health and medical care.

In this and the following section, however, some attempts to estimate changes in public health care productivity will be presented. The output of the health care system is at least as complex as that of the manufacturing industry. So, these estimates of productivity changes are based on output and cost data for various kinds of health services supplied by the public sector. The next section summarizes three studies on the development of the costs of surgery for selected illnesses 1955–1965–1975, while this section presents an estimate of the development of real production in inpatient somatic care 1964–1976.⁶

Total health care consumption and production increased by 5.0 per cent per year in fixed prices between 1964 and 1976, according to the national accounts; and inpatient care increased even more than that, 6.3 per cent a year. However, the number of admissions (and discharges) in inpatient somatic care, which may seem to be a fairly natural quantitative output measure, increased by not more than 2.4 per cent per year. So, productivity within inpatient somatic care has apparently decreased: the relative increase in the number of admissions is less than the relative increase according to the national accounts and the latter measure is based on the assumption of zero growth in productivity. On the other hand, the importance of this conclusion should not be overemphasized. Treatments do differ in terms of their resource use. Thus, a simple unweighted sum will seldom provide a good measure of the development of production and productivity over time.

At present there are data available for Sweden, published by the Swedish National Board of Health and Welfare (Socialstyrelsen, Patientstatistik, various years), which make a detailed description of inpatient somatic care possible. Unfortunately, data on the costs of hospital care are available only at a highly aggregated level. Thus, the very detailed data on discharges and bed days cannot be fully employed in making a weighted measure of hospital output. Data on average cost per day in different hospital departments (Landstingsförbundet 1978) are available, however, and they can be employed, when estimating the weights of discharges for different disease categories, even though not all differences in costs can be taken into account. This has been the procedure followed here. The first year of study is 1964, which is the first year for which there are detailed inpatient statistics. The last year of study is 1976, which is the latest year at present for the inpatient statistics but also the same year as that of the study

made by the Federation of County Councils in Sweden (Landstingsförbundet 1978).

First, using inpatient statistics from the Uppsala health care region, published by the Swedish National Board of Health and Welfare, and the data on costs per bed day in different hospital departments published by the Federation of County Councils in Sweden, an estimate of the production development will be made, taking the number of discharges in a certain disease category as the basic sub-activity. But before presenting the results, it might be observed that the total number of discharges in inpatient somatic care in the Uppsala health care region rose from 150,725 in 1964 to 198,284 in 1976, *i.e.* an increase by about 31.6 per cent or by 2.3 per cent a year in average, which is approximately the same as for the country as a whole (2.4 per cent).

For the estimate the following (Paasche) quantity index was used:

$$I_{64,76} = \frac{\sum_{i=1}^{18} p_{i,76} q_{i,76}}{\sum_{i=1}^{18} p_{i,76} q_{i,64}} \quad (\text{Eq. 3.2}),$$

where $p_{i,76}$ denotes the average cost per discharged patient in disease category no. i in 1976, $q_{i,76}$ the number of discharges in disease category no. i in 1976, and $q_{i,64}$ the corresponding number in 1964. The 18 categories consist of the 17 WHO main disease categories and one category, comprising treatments not allocated.

Thus, in order to isolate the volume aspect, the number of discharges in different disease categories in both years are aggregated using the cost of treatment for each category, respectively, in one and the same year. The calculation results in an index value of 1.374, *i.e.* the increase in production becomes 37.4 per cent in total or 2.7 per cent in average per year, when this measure of production is used. This figure may be compared with the 2.3 per cent a year which was found when all "treatments" were treated as homogeneous services. So, when taking into account the fact that disease categories requiring comparatively more resources increase their shares of the number of discharges, production would increase by a further 0.4 per cent a year. The cost of treatment in various main disease categories in 1976 and the number of discharges distributed percentagewise by disease categories in 1964 and in 1976 are reproduced in Table 3.6.⁷

There is, however, a further possibility of making a still more refined disaggregation of the production of inpatient somatic care. It is possible to distribute the number of discharges in each disease category over four types of hospital departments: general care, acute care (non-surgical specialty), acute care (surgical specialty), and long-term care. This makes it possible to use "treatments" in a certain disease category performed in a certain hospital department as the sub-activity, when total production of inpatient somatic care is estimated. Then there are 72 different health care services to be aggregated using the average costs of each

Table 3.6. Percentage distributions of the number of discharges from somatic hospitals allocated by disease category in 1964 and 1976; and the estimated average cost per discharged patient in 1976.

Disease category	Distributions of number of discharges, percentage		Cost per discharged patient (SEK)
	1964	1976	
1. Infective and parasitic diseases	4.0	3.0	5,500
2. Neoplasms	8.5	9.9	8,400
3. Endocrine and metabolic diseases	4.3	4.0	7,800
4. Diseases of the blood	1.2	0.7	5,900
5. Mental disorders	1.4	1.2	15,100
6. Diseases of the nervous system	5.3	5.7	10,300
7. Diseases of the circulatory system	11.7	13.8	12,300
8. Diseases of the respiratory system	9.1	9.1	5,500
9. Diseases of the digestive system	12.9	9.0	5,200
10. Diseases of the genitourinary system	9.3	7.8	4,500
11. Complications of pregnancy and childbirth	5.6	2.8	2,800
12. Diseases of the skin and subcutaneous tissue	1.6	1.6	7,600
13. Diseases of the musculoskeletal system and connective tissue	4.6	5.4	9,500
14. Congenital anomalies	1.4	1.8	3,900
15. Certain causes of perinatal morbidity and mortality	0.9	1.1	2,900
16. Symptoms and ill-defined conditions	8.2	8.2	4,700
17. Accidents, poisonings and violence	8.9	11.0	7,600
18. All other	1.1	3.4	3,500
Total	100 %	100 %	7,300

Note: The names of the WHO main categories have been somewhat shortened; their full names are given in Table 4.3.

service as weights. The (Paasche) quantity index then becomes:

$$Q_{64,76} = \frac{\sum_{i=1}^{18} \sum_{j=1}^4 p_{ij,76} q_{ij,76}}{\sum_{i=1}^{18} \sum_{j=1}^4 p_{ij,76} q_{ij,64}} \quad (\text{Eq. 3.3})$$

where $p_{ij,76}$ denotes the average cost per discharged patient in disease category no. i in hospital department no. j in 1976, while $q_{ij,76}$ and $q_{ij,64}$ denotes the number of discharges in disease category no. i in hospital department no. j in 1976 and in 1964, respectively.

The index value becomes 1.441, *i. e.* the production of inpatient somatic care increased by 44.1 per cent in total or 3.1 per cent a year, according to this measure of production. The result may be compared with the 2.3 per cent found when discharges for different disease categories were treated equal or with the 2.7 per cent which was the result of distinguishing between treatments in different main disease categories. So, it seems possible to conclude that the total production of inpatient somatic care rose by 3.1 per cent a year in average, of which 2.3 per cent was the result of an increased number of discharged patients; 0.4 per cent the result of the fact that disease categories requiring more resources increased their shares of the number of discharges; and further 0.4 per cent due to the fact that more expensive departments have increased their shares of the number of discharges in each disease category. (In Table 3.7 the number of treatments in each disease category is distributed percentagewise by type of hospital department in 1964 and in 1976.)

Still, the result (an increase by 3.1 per cent a year) is relatively far from the official national accounting figures (5.0 per cent for total health care and 6.3 per cent for inpatient care), which – it should be repeated – are based on the assumption of zero productivity change. Apparently, the national accounting statistics overestimate the development of health care production in real terms, at least as far as inpatient somatic care is concerned. It should be noticed, however, that even a disaggregation into 72 different kinds of services is rather crude.

Above all, differences in the average cost may be underestimated. Since the investigation made by the Federation of County Councils is concerned with average day cost in different hospital departments, it was impossible to make a better estimate of the treatment costs in 1976 than by a simple multiplication of the average day cost in a certain hospital department with the mean length of stay in days for a certain disease category in the hospital department in question. This is not quite satisfactory, because bed days are not identical even within the same hospital department, a fact which will be further stressed in the next chapter.

Because of the day-to-day cost pattern during the episode of illness, an increase in the number of bed days by 1 000 days by letting every one of 1 000 patients stay an extra day will have quite different consequences for hospital costs than by increasing the number of patients with 100, each staying 10 days in average. This is one reason why the number of bed days is worse as an output measure than the number of discharges. For the sake of completeness, however, the equivalent estimate of the development of the production of inpatient somatic care will be made, using the number of bed days as output measure. First, if all bed days are treated equally, the rise in total production of inpatient somatic care in the Uppsala health care region was 27.3 per cent in total between 1964 and 1976 or 2.0 per cent a year in average. (In the country as a whole the increase averaged 2.3 per cent a year.) Second, taking the changes in the distribution of bed days between the 18 disease categories into account by making an index of the same type as I above, the rise will be only 17.7 per cent for the whole period

Table 3.7. The number of discharges distributed by type of hospital department, percentages for each disease category in 1964 and 1976; and the average cost of treatment by type of hospital department in 1976.

Disease category	1964				1976			
	General care	Acute care, non-surgical specialty	Acute care, surgical specialty	Total	General care	Acute care, non-surgical specialty	Acute care, surgical specialty	Total
1. Infective and parasitic diseases	22.0	66.9	13.9	100 %	0.6	84.9	12.9	100 %
2. Neoplasms	5.5	28.0	61.3	100 %	0.7	38.1	57.4	100 %
3. Endocrine and metabolic diseases	6.7	71.2	19.4	100 %	2.6	73.9	15.2	100 %
4. Diseases of the blood	7.1	59.5	31.5	100 %	1.3	69.1	25.5	100 %
5. Mental disorders	11.1	70.3	6.1	100 %	9.6	67.8	5.1	100 %
6. Diseases of the nervous system	2.9	29.8	63.4	100 %	1.1	29.6	59.1	100 %
7. Diseases of the circulatory system	10.4	58.4	21.3	100 %	2.5	72.8	14.6	100 %
8. Diseases of the respiratory system	8.7	46.2	41.4	100 %	1.7	64.4	29.4	100 %
9. Diseases of the digestive system	5.9	14.7	78.8	100 %	0.6	14.9	83.6	100 %
10. Diseases of the genitourinary system	6.4	10.7	82.2	100 %	0.6	26.2	72.5	100 %
11. Complications of pregnancy and childbirth	4.3	0.4	95.3	100 %	—	0.9	99.1	100 %
12. Diseases of the skin and subcutaneous tissue	7.4	71.0	21.1	100 %	0.5	73.0	23.6	100 %
13. Diseases of the musculoskeletal system and connective tissue	7.1	37.6	49.8	100 %	2.0	23.2	57.7	100 %
14. Congenital anomalies	1.0	40.4	58.4	100 %	—	41.7	57.8	100 %
15. Certain causes of perinatal morbidity and mortality	—	—	100.0	100 %	—	0.5	99.5	100 %
16. Symptoms and ill-defined conditions	7.0	39.5	52.5	100 %	1.5	44.5	50.7	100 %
17. Accidents, poisonings and violence	8.6	9.8	79.4	100 %	0.9	14.7	80.3	100 %
18. All other	1.3	34.6	51.2	100 %	1.7	53.5	42.3	100 %
All categories	4.3	37.2	55.2	100 %	1.4	43.4	49.4	100 %
Average cost of treatment in 1976	—	—	—	—	11,400	5,200	5,500	7,300

of time or 1.4 per cent a year. Finally, if an index of the same type as Q above is made in order to take account for the effects of changes in the distribution of bed days between the four types of hospital departments, too, the increase in total production will be 10.7 per cent totally or 0.8 per cent a year. So, if the number of bed days is used as a measure of output, estimated production *decreases* as the level of disaggregation of basic data is increased.

Even if the data of costs of treatment could be improved in the future, thereby increasing the possibilities for making good estimates of the health care production, there are still problems left to be solved. The approach used above implicitly assumes that the quality of health care services never changes, in any case, does not change markedly. It is difficult to assess the validity of this implicit assumption. Adjustment of the output measure for quality changes would require a knowledge of a number of factors, *e. g.* recurrences, life expectancy, and waiting times. Shorter periods of convalescence at home after the hospital stay or a better recovering with fewer recurrences and increased life expectancy are factors which raise the quality of a treatment and which, thus, could motivate an upward adjustment of the development of production and productivity. Longer waiting times before treatment or higher utilization of the time of relatives for helping the patient at home after treatment in hospital means, on the other hand, that the estimates should be adjusted downwards. Lack of suitable data makes it, however, impossible to make such adjustments. Most frequently, it is quite impossible to know when and in what direction the adjustment is to be made. There are, for instance, no published data available showing whether queues and waiting times have declined or grown.

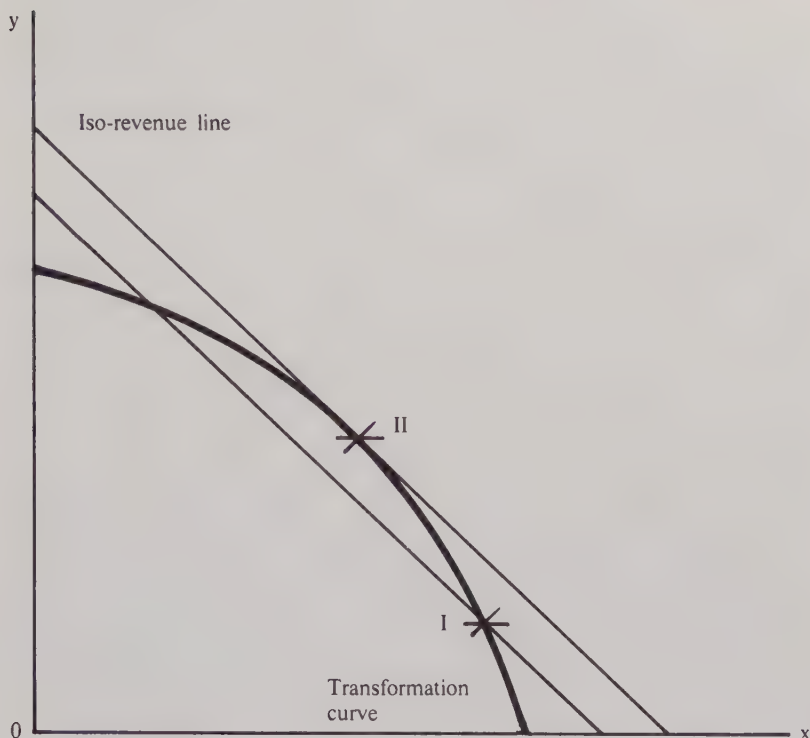
The index number problem

In every fixed-prices computation there is an index problem. Here, the index number problem of the estimation of the changes in inpatient somatic care will be analysed. The argument is developed by means of two-dimensional diagrams which facilitate simplicity of exposition without significant loss of generality. So, it will be assumed that somatic care only consists of two different services (two different treatments), x and y , and not 18 or 72 services as in the estimation. The number of services of each type which somatic care can produce during a year with the available resources and with given technical knowledge is limited by the transformation (or production possibility) curve, shown in Figure 3.1.

By construction, the transformation curve shows, for each value of x , the maximum amount of y which it is possible to produce during the year. With available limited resources and given technical knowledge it is, therefore, possible to produce x and y in such amounts that lie either exactly on the transformation curve or somewhere inside it but never in such amounts that lie outside the transformation curve.

In Figure 3.1 it is also shown that an increase in production (or

Figure 3.1. Increased value of production by way of changed allocation of resources in a state of fixed supply of factors of production and given technical knowledge.



in the production value) may be the result of a changed allocation of resources. Both the service bundle I and the service bundle II are feasible.

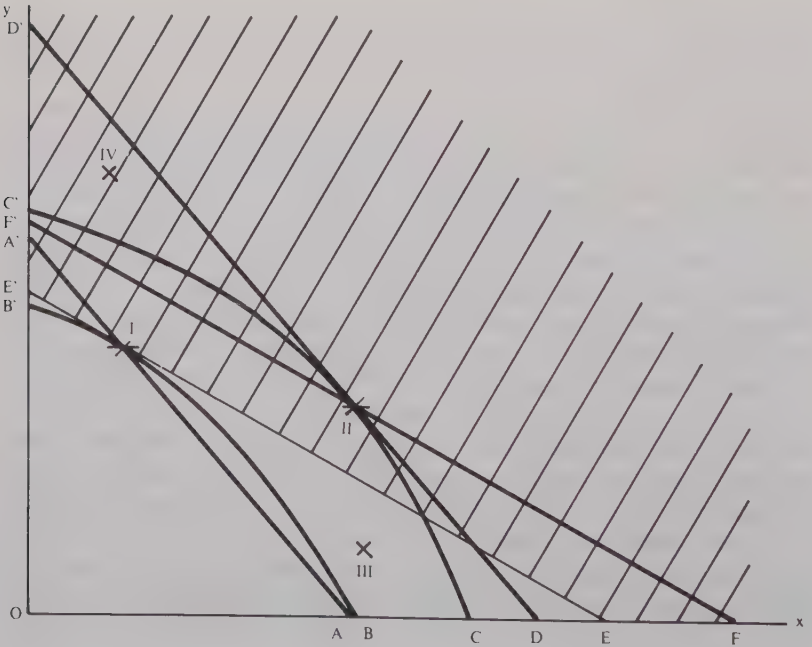
Bundle II is, however, worth more than bundle I at given prices of the two services. This is shown by the two iso-revenue lines, each representing all the service bundles which imply a certain definite total revenue (or rather a certain definite production value, since there are no revenues here in the usual meaning of the word). Iso-revenue lines situated further away from the origin represent higher production values. Obviously, the service bundle represented by the point where one of the iso-revenue lines is tangent to the transformation curve has the maximum production value possible with existing limited resources and given technical knowledge.

The increase in inpatient somatic care which was observed for the period 1964–1976 may, of course, partly be the effect of better utilization of health care resources. However, in analyses of this kind it is usually assumed that the allocation of resources is efficient, when the opposite is impossible to prove. This efficiency assumption has to be made here, too. The question then is, whether it is possible to conclude from our data how much the productive capacity has increased from 1964 to 1976 as measured by how much the transformation curve has shifted

further away from the origin. There is, however, only one observation of each transformation curve out of infinitely many points.

If the two points of observation were such that they meant an increase in the production of both services, then the answer evidently is that production has increased⁸. That is, however, not true for the inpatient somatic care studied here. For at least two of the 18 main disease categories the number of treatments has decreased since 1964. So, some services decreased, while other services increased. Even in this case, however, it is possible to go some way towards answering the question. In Figure 3.2 the observation for 1964 is represented by the point I. This point is assumed to lie on the transformation curve BB' , of which the iso-revenue line EE' is the tangent. The slope of EE' is determined by the 1964 prices of the two services. If an observation from 1976 lies in the shaded area in Figure 3.2, then at least some parts of the transformation curve for 1976 must obviously lie further away from the origin than the 1964 transformation curve. The estimated size of the increase may however, depend on what prices are used for the comparison. If the 1976 prices are used, the increase will be much higher in the example shown in Figure 3.2. Observations represented by points to the left of the iso-revenue line FF' must mean that the transformation curve lies nearer to the origin. In the figure the production value for 1964 at the 1964 prices is shown by the iso-revenue line EE' and for 1976 at the 1964 prices by FF' . The value of production for 1964 at the 1976 prices is represented by the iso-revenue line AA' and for 1976 at the 1976 prices by DD' . The parallel shift in the iso-

Figure 3.2. The estimate of the increase in production depends on the prices, or weights chosen.



revenue line from AA' to DD' (*i. e.* the increase in production at the 1976 prices) is larger than the parallel shift of EE' to FF' (which represents the increase in production at the 1964 prices).

A quantity index based on prices in the final year and a simple weighted sum of the quantities of goods or services is called the Paasche quantity index. The Laspeyres index, on the other hand, employs the prices in the initial year. On the whole, the Paasche and Laspeyres indices state the upper and lower boundary of the "true" measure. Here it was not possible, however, to analyse the sensitivity of the results to changes in the choice of prices. Only prices for one year, 1976, were available and hence, it was only possible to estimate the Paasche index. A further limitation in the analysis possibilities should be noticed, a limitation which is illustrated in Figure 3.2. From the figure it is evident that an observation represented by a point somewhere between the iso-revenue line EE' and the transformation curve BB', for instance point III, will be conceived as a smaller value of production than I, if 1964 prices are used, but as a higher value of production than I, when 1976 prices are used. Thus, the possibility of increased production and productive capacity cannot be ruled out, even if the production value at 1964 prices falls. The equal is true for any observation which could be represented by a point between the iso-revenue line DD' and the transformation curve CC', for instance point IV. This point will appear to represent a higher value of production than II at 1964 prices but as a lower value at 1976 prices. One cannot, therefore, completely exclude the possibility that production decreases according to a correct index, even if the value of production at 1976 prices increases.

Changes in the costs of surgery for selected illnesses, 1955–1965–1975

Alternatively, productivity changes may be estimated by calculating changes in the real cost of providing a specific health service. The hospital accounting system used in all public hospitals in Sweden does not furnish such data routinely, however, but we have made three studies in which the costs of hospital treatment were estimated in a rather detailed way.⁹ The studies are concerned with the three most common surgical treatments in Sweden: cholecystectomies, inguinal hernia repair, and appendectomies. The results of the three studies will be summarized here.

Materials and methods

In order to exclude the effects of changed age or sex distribution or other influencing factors we chose to examine (1) women, aged 45–59, with uncomplicated elective cholecystectomies (gallstone operations), (2) men, aged 50–59, with elective, one-sided, non-relapsing inguinal hernia repair, and (3) men, aged 20–29, with appendectomies, respec-

tively. So, for each surgical procedure rather homogeneous groups of patients were selected.

All the records of patients who satisfied these criteria and who were treated in the Surgical Department of Lund University Hospital during 1955, 1965, and 1975 were examined. For cholecystectomies 59, 54, and 33 patients from 1955, 1965, and 1975 respectively, satisfied the criteria; for inguinal hernia repair 33, 35, and 49 patients from 1955, 1965, and 1975 respectively, filled the criteria; and for appendectomies 51, 47, and 54, respectively, did so. In all the three studies a few patients had to be excluded, due to lack of information about the length of operation.

From the patient records we noted as far as possible every input, *i. e.* length of operation, X-ray examination, clinical physiological examinations, bed days ("hotel services"), *etc.*, used in the treatment of the patient. We then calculated the costs of treatment for each patient in fixed prices. Because of the absence of markets in public health care, all prices of inputs are not readily available, so they have to be calculated in some indirect way. We made no such imputations of our own but used the prices calculated for 1971 in a study by Spek and Thorburn (1976).¹⁰ For some inputs, for instance the use of drugs, the imputed prices are based on market prices. For most inputs, however, the imputed prices are based on a calculation of the costs involved.

Results

The main results are summarized in Tables 3.8–3.11 for cholecystectomies, inguinal hernia repair, and appendectomies, respectively.

The mean cost for a cholecystectomy decreased by 18 per cent between 1955 and 1965 and by further 7 per cent between 1965 and 1975. (The observed decrease in costs corresponds to increases in productivity by 2.0 per cent and 0.8 per cent in average per year, respectively.) The 7 per cent decrease between 1965 and 1975 is not statistically significant. When we tested the hypothesis that the observations from 1965 and 1975 are samples of the same population, it appeared that the variation within each sample is great in comparison with the differences between them. So the null hypothesis that they belong to the same population was accepted ($F = 1.35$; $\nu_1 = 2$, $\nu_2 = 86$ DFR).

Table 3.8. Mean cost (and standard deviation) expressed in 1971 level of cost (SEK) for a cholecystectomy*.

Year	N	Totally		Preoper- atively	Peroper- atively	Postoper- atively
		Mean	SD			
1955	57	4,391	153	962	910	2,519
1965	54	3,585	129	746	970	1,869
1975	32	3,340	169	677	1,303	1,360

* Total surgical procedure and divided on preoperative, peroperative and postoperative costs.

Source: Lindgren *et al.* (1979).

Table 3.9. Mean cost (and standard deviation) expressed in 1971 level of cost (SEK) for an inguinal hernia repair.

Year	N	Totally		Preoper- atively	Peroper- atively	Postoper- atively
		Mean	SD			
1955	26	2,230	405	558	371	1,301
1965	29	1,978	660	674	492	812
1975	49	1,377	572	461	660	256

Source: Bengmark *et al.* (1981).

Table 3.10. Mean cost (and standard deviation) expressed in 1971 level of cost (SEK) for an inguinal hernia repair in 1975; in- and out-patients respectively.

	N	Totally		Preoper- atively	Peroper- atively	Postoper- atively
		Mean	SD			
Inpatients	28	1,783	411	586	780	417
Outpatients	21	835	150	336	499	—

Source: Bengmark *et al.* (1981).

For an inguinal hernia repair, the mean cost decreased by 11 per cent between 1955 and 1965 and by another 30 per cent between 1965 and 1975 or, totally, by 38 per cent from 1955 to 1975. (The observed decrease in costs corresponds to increases in productivity by 1.0 per cent and 3.7 per cent in average per year, respectively.) The 11 per cent decrease between 1955 and 1965 is not statistically significant ($F = 1.41$; $\nu_1 = 2$, $\nu_2 = 55$ DFR). The significant decline between 1965 and 1975 is mainly due to the fact that hernia repairs to a large degree are made as day-case surgery in 1975. The decrease in the costs for inpatients was about the same between 1965 and 1975 as between 1955 and 1965, *i. e.*, 10 per cent and 11 per cent, respectively (Table 3.10).

For appendectomies, the mean cost apparently decreased by 9 per cent between 1955 and 1965 but remained almost unchanged from 1965 to 1975. The decrease is not statistically significant, however. Using analysis of variance, the null hypothesis that the observations from 1955, 1965, and 1975 are all drawn from the same population was not rejected ($F = 1.41$; $\nu_1 = 3$, $\nu_2 = 152$ DFR). There is no significant difference between the costs in 1955 and 1965, taken separately, either ($F = 1.25$; $\nu_1 = 2$, $\nu_2 = 98$ DFR).

Table 3.11. Mean cost (and standard deviation) expressed in 1971 level of cost (SEK) for an appendectomy.

Year	N	Totally		Preoper- atively	Peroper- atively	Postoper- atively
		Mean	SD			
1955	51	1,760	490	128	313	1,319
1965	47	1,603	487	104	435	1,064
1975	54	1,597	379	159	594	844

Source: Ambjörnsson *et al.* (1981).

Table 3.12. Cholecystectomies. Mean length of operation in minutes and the mean number of bed days, totally, and divided preoperatively and postoperatively in 1955, 1965, and 1975.

Year	Mean length of operation in minutes	Mean number of bed days		
		Totally	Preoperatively	Postoperatively
1955	65	11.6	2.0	9.6
1965	72	8.4	1.3	7.1
1975	89	6.1	1.1	5.0

Source: Lindgren *et al.* (1979).

Note: The day of admission and the day of discharge counted as half a day each.

A general feature, which can be seen in Tables 3.8–3.11. is that the cost of peroperative measures increased while the cost of postoperative measures decreased; the preoperative costs did not change uniformly. The rise in the peroperative costs is mainly explained by increased length of operation, while the reduced number of postoperative bed days is a main factor contributing to the decrease in the postoperative costs, as can be seen in Tables 3.12–3.14.

For a cholecystectomy the mean length of operation increased by 12 per cent from 1955 to 1965 and by a further 22 per cent from 1965 to 1975. More than compensating for this rise in the length of operation, there is a sharp decline in the average duration of hospital stay. The mean length of stay decreased by about 27 per cent between 1955 and 1965 and by the same amount between 1965 and 1975.

For an inguinal hernia repair the increase in mean length of operation is 34 per cent from 1955 to 1965 and further 74 per cent and 9 per cent for in- and out-patients, respectively, between 1965 and 1975. This

Table 3.13. Inguinal hernia repair. Mean length of operation in minutes and the mean number of bed days, totally, and divided preoperatively and postoperatively in 1955, 1965, and 1975.

	Mean length of operation in minutes	Mean number of bed days		
		Totally	Preoperatively	Postoperatively
1955	32	5.8	1.0	4.8
1965	43	4.3	1.2	3.1
1975 (in-patients)	75	2.4	0.8	1.6
1975 (out-patients)	47	—	—	—

Source: Bengmark *et al.* (1981).

Note: See note to Table 3.12.

Table 3.14. Appendectomies. Mean length of operation in minutes and the mean number of bed days, totally, and divided preoperatively and postoperatively in 1955, 1965, and 1975.

Year	Mean length of operation in minutes	Mean number of bed days		
		Totally	Preoperatively	Postoperatively
1955	26	4.4	0.3	4.1
1965	37	3.4	0.3	3.1
1975	44	2.6	0.3	2.3

Source: Ambjörnsson *et al.* (1981).

Note: See note to Table 3.12.

decreased productivity of the surgeon was, however, counterbalanced by increased productivity in the wards. The mean duration of total hospital stay for inpatients decreased by 26 per cent from 1955 to 1965 and by 44 per cent from 1965 to 1975. Another factor contributing to the fall in postoperative costs between 1965 and 1975 is the use of day-case surgery for 43 per cent of the patients in 1975. For these patients there are, naturally, no postoperative hospital costs at all.

Underlying the zero change in the cost of an appendectomy there are two highly significant, but counterbalancing, changes. The postoperative costs decreased by 36 per cent from 1955 to 1975, but during the same period of time the peroperative costs rose by 90 per cent. The cost of postoperative measures decreased because of the decline in the number of postoperative bed days. The mean duration of hospital stay *in toto* decreased by about 23 per cent between 1955 and 1965 as well as between 1965 and 1975. The main factor contributing to the rise in the peroperative costs is the increased length of operation time. The mean length of operation rose by 42 per cent between 1955 and 1965 and by 19 per cent between 1965 and 1975.

For cholecystectomies the decreased productivity of surgeons, shown as increased length of operation, is largely the result of a rising proportion of young and inexperienced surgeons (Table 3.15). The same explanatory factor is probably behind the increases in the length of operation for appendectomies and inguinal hernia repair, too.

Table 3.15. The surgeons' mean number of years in the profession after state authorization.

Year	Mean number of years
1955	12
1965	9
1975	3

Source: Lindgren *et al.* (1979).

Not only the length of operation but also several other factors changed between the three years studied. For cholecystectomies, for instance, such preoperative measurements as X-rays of the heart and lung increased from 1965 to 1975. Second, every gallbladder was examined in 1975 by a pathologist, which was not the case in 1955, nor in 1965. Finally, in the postoperative treatment the use of parenteral glucose solutions were considerably more common in 1955 than in 1965 or in 1975. The actual cost for the parenteral solutions given was low *per se*. It was, however, not possible to estimate the extra labour used, which might be of some importance. Nor was it possible to estimate the activity of the physiotherapists during the years studied, but it can be assumed that this activity increased from 1955 to 1975. It is impossible to determine the extent to which these tendencies in the postoperative treatment are offsetting since no data are available.

Limitations of the three studies

One of the limitations of the studies was just mentioned. In this section the assumptions on which the estimates were based will be further examined: (1) the calculation of hospital costs and (2) the implicit assumption of constant quality of output.

Firstly, it had to be assumed that the "hotel" cost per day is the same for the patients in our study as for the average patient at the surgical department. An alternative assumption is that the patients studied would require hotel services each bed day corresponding to SEK 200 (instead of SEK 257) for the gallstone patients. This would result in a decrease in costs by 17 per cent (instead of 18 per cent) between 1955 and 1965 while the decrease would be as small as 4 per cent (instead of 7 per cent) between 1965 and 1975. If SEK 300 is a more appropriate estimate, the decrease in costs (and increase in productivity) would, naturally, be larger than our estimate. The decrease in costs will then become 19 per cent between 1955 and 1965 and 9 per cent between 1965 and 1975. Similar changes in the estimates will occur for inguinal hernia repair and appendectomies as well.

It was also assumed that the hotel cost per day remained unchanged, in real terms, between the three years studied. Actually the first post-operative days in 1955 for the gall-stone patient should count slightly higher than in 1965 and 1975, because of the labour involved in the extensive use of parenteral glucose solution in 1955. On the other hand, the activity of physiotherapists has most likely increased for all patients since 1955. Consequently, the direction of bias in the imputed price of "hotel" services is indeterminate.

The decrease in cost for all the three surgical procedures is slightly underestimated because of the assumption of constant real cost of laboratory tests and X-ray examinations, despite the fact that laboratories and X-ray departments have probably experienced markedly large increases in productivity due to technical progress since 1955.

Secondly, implicit in the estimates of the changes in the costs of surgery, there is also an assumption of constant quality of output. The validity of this assumption, is, however, difficult to determine. It seems,

however, fairly reasonable for the three surgical procedures studied. Time of convalescence at home after surgery does not seem to have changed markedly since 1955 for the three diseases studied. Nor do recurrence or operation mortality rates. But there are other factors which may have changed.

For elective inguinal hernia repair, for instance, one cannot be quite sure that the patient characteristics remained the same with the introduction of day-case surgery. There are no indications that the incidence of inguinal hernia has changed during the last decades. Thus, the increase in the number of hernia repairs made in 1975 compared with 1955 and 1965 (see Table 3.9) may be a response to the decrease in the costs per treatment. But one possible interpretation of the facts is that the new method was not introduced for all patients with inguinal hernia. On the contrary, the persons treated in inpatient care in 1975 may be patients with exactly the same characteristics as in 1955 and 1965, whereas all the new patients may be persons with less painful and not so marked inguinal hernia, which may be easily suitable for day-case surgery. It is rather likely that patients are allocated to inpatient and outpatient care, not in a stochastic, but in a rather systematic way. If that is the case, the new method should, ideally, be treated as a new health service, provided for a certain group of inguinal hernia patients, rather than as a new method of providing the same health service as before for the whole group of inguinal hernia patients.

There are other possible changes in the quality of treatment which may have occurred but which were impossible to evaluate. It may be, for instance, that the patient in 1975 *may* have felt safer than the patient in 1955 and 1965, due to the more careful preoperative testing. There has not, though, been possible to adjust the estimates for the benefit which the patient may have because of the reduced length of hospital stay. If the time of convalescence at home is unchanged, then shorter hospital stay means that the person can participate in normal work and leisure activities earlier than before.

There are, finally, no data available which could be used for adjusting the estimated productivity development for changes in waiting time before the operation.¹¹ The price of waiting may be high. Persons on the waiting lists may have pains and suffer from restricted capacity. They must, further, put up with the uncertainty in not knowing when they will, finally, be treated. In addition to that, they have to tolerate a delay in the delivery of a service which they (normally) find desirable. A promise of delivery three years from now is not of quite the same value as a promise of delivery within three weeks. In theory, goods or services with identical physical qualities but with different times of delivery are treated as separate goods or services. Adjustments for changes in the queueing costs are, however, not made for any other good or service in the national accounts, either.

The index number problem

There is an index number problem in the estimates of the changes in the costs of cholecystectomies, inguinal hernia repair, and appen-

dectomies. This is, however, analogous to the index number problem discussed above in connection with the presentation of results from the study on the development of somatic inpatient care. Therefore, the arguments will not be repeated here.¹²

Discussion

The study referred to in the second section and the three studies summarized in the third section of this chapter seemingly give opposite results regarding the development of public health care productivity. In the former study the productivity of inpatient somatic care seemingly declines by two to three per cent a year, whereas there are at least some indications of increasing productivity in the micro-orientated studies on the changes in the costs of surgery for gallstones and inguinal hernia repair (the costs of appendectomies remained unchanged). There are, however, several reasons why the results do not necessarily conflict.

First, the Surgical Department of Lund University Hospital could, for instance, be atypical of the health care industry in general as regards patients' characteristics and/or methods of treatment. This may well be the case, but as far as the average length of stay is concerned, the Uppsala health care region shows the same patterns of development as Lund for the three surgical procedures studied (*Source*: Socialstyrelsen, Patientstatistik, various years).

It is then more likely that surgery for these three diseases of the digestive system have actually become more productive, while the development at large shows a decline in productivity. The decline in productivity, shown in the aggregate data of the Uppsala health care region, may, for example, be partly explained by the changed age distribution. For each treatment the costs of treatment increases with age; more elderly people treated in the hospitals will then, *ceteris paribus*, imply increased use of resources for every treatment. In the three micro studies, on the other hand, the effects of age were kept constant. However, the age distribution has not changed so much that this fact alone can explain the decline in productivity found in the macro-orientated study.

A third reason is that it may well be true that the use of resources in direct connection with the treatment diminished in the way the micro studies indicate, but that at the same time various overhead costs have increased so heavily that the total result nevertheless becomes a decline in productivity. Such rising overhead costs may be partly due to increasing difficulties in the management (Ståhl 1980). There has, for instance, been an increasing tendency to involve not only the staff of physicians but practically all staff categories in health care decision making, and this has apparently led to an increased number and length of time-consuming staff meetings. A general tendency of shorter working hours for all personnel also makes planning and management extremely difficult because of the loss of continuity. Over-time work is, for instance, more and more compensated in the form of extended leisure time. High marginal tax rates and income related subsidies for housing, day care centres, *etc.* benefit those with shorter working hours. Accordingly,

part time work and long leaves of absence are more the rule than the exception (Ståhl 1980).

The results of the three micro studies can also be compared with the results found by Scitovsky (1967) and by Scitovsky and McCall (1976), who used principally the same methodology as we did in calculating the changes in costs of treatment of selected illnesses.¹³ Their main results are reproduced in Tables 3.16 and 3.17.

As Table 3.16 indicates, most of the changes in treatment during the period 1951–1964 were, on balance, cost-raising. The sole exception was otitis media (middle ear infection) in children. The main explanation in this case, according to Scitovsky (1967) and Scitovsky and McCall (1976), was the shift from home visits to office visits. In the case of maternity care, changes in treatment were more or less neutral, cost-raising changes (for instance, an increase in the number of laboratory tests per case) more or less offsetting cost-saving changes (for instance, a decrease in the average length of stay). For conditions where changes in treatment were, on balance, cost-raising, the main factor that raised costs was an increase in the number of laboratory tests and X-rays per case. A main factor behind the increase in the costs of treating forearm fractures was the substitution of orthopedic surgeons for general surgeons; the average fee of an orthopedic surgeon was about 75 per cent higher than that of a general surgeon for the same procedure in 1951.

Table 3.17 summarizes the Scitovsky and McCall findings concerning the period 1964–1971. It may be observed that costs of treatment of conditions requiring hospitalization rose at a considerably faster rate than those of conditions treated on an ambulatory basis. Comparing Tables 3.16 and 3.17 it is also evident that many of the trends observed

Table 3.16. Average costs of treatment of selected illnesses for patients treated at Palo Alto Medical Clinic and at Stanford University Hospital, 1951 and 1964; 1964 prices.

Illness	1951		1964		Annual rate of change
	\$	N	\$	N	
Otitis media (children)	22.31	96	18.34	156	-1.5
Appendicitis					
Simple	571.21	99	591.51	89	0.3
Perforated	888.18	6	958.72	17	0.6
Maternity care	505.80	52	502.92	100	0.0
Cancer of the breast	1 295.06	21	1 503.93	30	1.2
Forearm fractures (children)					
Cast only	82.89	7	82.89	37	0.0
Closed reduction, no general anesthetic	89.30	3	121.76	25	2.4
Closed reduction, general or regional anesthetic	167.93	5	365.33	23	6.2

Note: Maternity care is exclusive of costs of outpatient drugs and prescriptions. Cancer of the breast is exclusive of costs of surgery performed as a procedure independent from the mastectomy, and of miscellaneous outpatient medical goods and services.

Source: Scitovsky and McCall (1976).

Table 3.17. Average costs of treatment of selected illnesses for patients treated at Palo Alto Medical Clinic and at Stanford University Hospital, 1964 and 1971; 1971 prices.

Illness	1964		1971		Annual rate of change	Significant at 5 %
	\$	N	\$	N		
Otitis media (children)	24.18	156	25.13	257	0.5	no
Appendicitis						
Simple	1 040.20	89	1 062.58	41	0.3	no
Perforated	1 811.53	17	2 062.17	11	1.9	no
Maternity care	852.87 (880.53)	100	786.32 (807.08)	154	-1.1 (1.2)	yes
Cancer of the breast	2 491.52 (2 582.40)	30	2 356.71 (2 557.35)	35	0.8 (-0.1)	no
Forearm fractures (children)						
Cast only	94.04	37	97.01	48	0.4	no
Closed reduction, no general anesthetic	199.32	25	245.79	20	3.0	yes
Closed reduction, general or regional anesthetic	573.61	23	521.92	18	-1.3	no
Myocardial infarction	2 461.08	28	3 279.87	48	4.2	yes
Pneumonia (nonhospitalized)	98.88	71	84.98	183	-2.1	no
Duodenal ulcer (nonhospitalized)	211.63	35	186.90	27	-1.8	no

Note: For maternity care the figures in brackets include costs of outpatient drugs and prescriptions, the others exclude such costs. For cancer of the breast the figures in brackets include the costs of surgery done as a procedure independent from the mastectomy, and of miscellaneous minor medical goods and services.

Source: Scitovsky and McCall (1976).

in the earlier period continued during 1964-1971. However, there were several conditions where changes in treatment were, on balance, cost-saving.

On the whole, our findings are in agreement with the results of these studies. In the Scitovsky (1967) and the Scitovsky and McCall (1976) studies as well as in our three studies the only significant trends toward lower costs are the reduction in duration of hospital stays and the increased tendency to treat patients in an ambulatory setting, for instance, day-case surgery. Every other change in the inputs used tends to increase costs.

Concluding remarks

At present, there are data available for Sweden which make a detailed quantitative account of the development of inpatient somatic and mental care possible. Unfortunately, available data on costs are not very detailed at all. In our studies we used, on one hand, very rough estimates of the costs per treatment, and, on the other hand, a very time-consuming

costing method to calculate the costs of treatment of selected illnesses. What is needed first of all, in order to improve the statistics and the future possibilities for analysis, is more information on costs.

In the present hospital accounting system, the hospital department is the basic accounting unit. This means that it is only possible to obtain data on average cost per bed day or per patient from the hospital accounts. The hospital accounting system offers no possible way by which the costs of different treatments or the differences in costs between patient categories could be determined. Naturally, nor does one know how a certain cost of treatment is distributed by various types of costs. Such information is, however, of vital importance, when various possibilities of making medical care more effective are to be investigated.

Thus, better data on costs are highly desired not only in measurements of production and productivity. Also when making cost-benefit or cost-effectiveness analyses such data on costs are of utmost importance. In connection with discussions of the possibilities of making cost-benefit analyses, it is usually asserted that costs are fairly easy to quantify but that the expected positive effects are very difficult to assess in monetary terms. As to health care not only benefits but also costs are hard to estimate with the present hospital accounting system. Data on costs of a certain treatment and on the distribution of costs by various types of inputs could considerably improve the quality of cost-benefit analyses in health care.

Data on the effects of health care are also lacking. At present there are few, if any, indicators which could be used in order to answer the questions whether quality has been raised or not, or rather, to determine the extent or size of the quality improvements that may have happened. Research on health indices is still in its infancy.¹⁴ Nevertheless, attempts towards improving the data on the effects of health care should be made, too.

In my opinion, one of the most important tasks for public health care administrators in the near future should be the improvement of data on health care costs and effects. With a few exceptions all the positive effects as well as all the costs of health care can, in principle, be traced to individual patients. This notion should really be the basis for a new hospital accounting system where the individual patient is the basic accounting unit, both of costs and of effects. Only then would the necessary data for production and productivity analyses be routinely collected within the health care system.

Notes

1. This section is based on Lindgren (1979 a and b).
2. *Cf.* United Nations (1968).
3. The BLS price index is described in Langford (1957). Certainly, the BLS price index was revised in 1964, but the general principles concerning the choice of health care services remain; see further Scitovsky and McCall (1976).

4. The average yearly productivity increase within private services was 3.0 per cent during 1964–1975 according to the Swedish national accounts. Notice, however, that *a priori* assumptions have already been used for certain private services. For private banks and insurance companies, for instance, productivity is assumed to grow by 2 per cent a year. The United Nations' guidelines (UN 1968) say nothing about *a priori* assumptions of productivity changes larger than zero for private services.
5. For a similar analysis as regards the public sector in West-Germany, see Brümmerhoff (1976).
6. This section is based on Hertzman and Lindgren (1980 a and b). I am indebted to Peter Hertzman, Swedish Institute for Health Economics, Lund, Sweden, for diligent research assistance.
7. The costs per hospital stay include all the health-care costs associated with that stay, *e. g.*, costs of physicians, surgeons, anaesthetists, nurses, drugs, X-ray examinations, *etc.* The costs per stay in 1976 have been calculated in the following way: Landstingsförbundet (1978) provided the basic data on the average costs per bed day in different hospital departments in Sweden 1976. In order to be comparable with the data on hospital utilization, the per-day costs in four types of hospital departments were first calculated on the basis of the data provided by Landstingsförbundet (1978). The four types of hospital departments are: general care, acute care (non-surgical specialty), acute care (surgical specialty), and long-term care. For acute care (non-surgical specialty), for instance, the estimated per-day cost was based on the costs per bed day in general medicine (SEK 454), pulmonary care (SEK 420), care of infective diseases (SEK 686), and pediatric medicine (SEK 814). The per-day cost of acute care (non-surgical specialty) was then calculated as a weighted average, the weights being each department's share of the total number of bed days for acute care (non-surgical specialty): $0.70 \times 454 + 0.09 \times 420 + 0.10 \times 686 + 0.11 \times 814 = \text{SEK } 514$. The costs per bed day in general care (SEK 514), acute care, surgical specialty (SEK 651), and long-term care (SEK 294) were calculated in the same way. The average cost per bed day for a specific disease category was then calculated as a weighted average, the weights being the shares of the total number of bed days of that disease category, for which each type of hospital department accounted. An example: $0.01 \times 514 + 0.16 \times 514 + 0.74 \times 651 + 0.09 \times 294 = \text{SEK } 596$ for diseases of the digestive system. The average cost per hospital stay for a specific disease category was calculated by multiplying the estimated average cost per bed day by the mean length of stay for that disease category.
8. However, even though it is true that production has increased between these two points of observation, this does not necessarily mean that the productive capacity has increased in a unique way. The two transformation curves may well intersect.

9. The studies were made by the present author in collaboration with surgeons from the Lund University Hospital; see Lindgren *et al.* (1979), Bengmark *et al.* (1981), and Ambjörnsson *et al.* (1981). As regards the appendectomy study, we are indebted to Håkan Brodin, Department of economics, University of Lund, Lund, Sweden, for diligent research assistance.
10. For every episode of hospital stay the cost of treatment was estimated on the basis of the following formula, also used by Spek and Thorburn (1976):

$$C = 257 + 257d + \sum_{i=1}^{170} q_i y_i \quad (\text{Eq. 3.4}),$$

where C denotes the cost of treatment, d the number of bed days, q_i the imputed price of the input no. i and y_i the quantity of that input. SEK 257 is the estimated costs common to all surgical patients and not depending on the length of stay or on the use of any other input or factor of production. Every type of laboratory tests, X-ray examinations, drugs, *etc.* were treated as separate inputs. The costs of operation were estimated by Spek and Thorburn in an extremely simplified way, referring all the costs, including the cost of the anaesthetist, to the length of operation in minutes. So, the imputed price of this input was the average cost per minute of operation, irrespectably of the number of surgeons, assistants *etc.* that were actually working during the operation of a specific patient.

11. The cholecystectomies and inguinal hernia repairs studied here were elective operations, *i. e.* the patients had been on the waiting list for some time. There is, naturally, no waiting list for appendicitis patients.
12. Instead, see, for instance, Beckerman (1976), chapters 10 and 11.
13. However, their studies used a wider concept of an episode of illness than we did. Due to data availability our studies were confined to episodes of hospital care including surgery, while Scitovsky and McCall (1976) defined episodes of illness as follows: *Otitis media and forearm fractures*, from date of diagnosis until there were no further entries in the patient's medical record for the episode; *appendicitis*, from date patient first sought medical care for abdominal pain until there were no further entries in the patient's medical record for the episode; *maternity care*, from date patient first consulted a physician for possible pregnancy through the last post-partum visit (cases requiring a Caesarian section were excluded); *cancer of the breast*, from date patient first consulted a physician for a lump in her breast until six months after the mastectomy; *pneumonia*, up to three months, beginning with date of diagnosis; *duodenal ulcer*, six months beginning with date of diagnosis; *myocardial infarction*, three months, beginning with date of diagnosis (patients who died before the end of the three-month period were excluded).
14. See, for instance, Culyer, Lavers, and Williams (1971), Bush *et al.* (1973), and Sintonen (1981).

4 Estimates of the direct costs distributed by type of service and by disease category

In Chapter 2 the description of the development of health care and the analysis of the factors behind the growth of health care expenditures presumed health care to be a homogeneous service. In the following chapter it was pointed out how complex the output of the health care system really is. In this chapter I shall try to disaggregate the total figures in two directions by estimating the distribution of the direct costs (1) by type of service and (2) by disease category.¹

In Table 4.1 the total costs of health care are subdivided by types of service. The data come from the national accounts. The official percentage for hospital care is, however, somewhat larger than the one given in the table. In the official Swedish national accounts hospital care includes not only inpatient care but also a considerable amount of outpatient care that is rendered at hospitals. The figures have here been adjusted to give a more realistic picture of the relative importance of inpatient and outpatient care in Sweden (see note to Table 4.1). In fact, 50 per cent of outpatient visits takes place in Swedish hospitals. As shown, inpatient care increased its share of the total costs of health care from about 50 per cent in 1964 to about 60 per cent in 1970. Thereafter, the share of inpatient care has remained at about 60 per cent. (The official national accounting figures for hospitals are 63 per cent in 1964 and 70 per cent in 1975.)

Here, as well as in the national accounts, drugs consist of drugs not used for inpatients. The costs of drugs used in hospitals are included in the costs of inpatient care.² The composition seems to be fairly similar to that of the USA but slightly different from that of France, as can be seen in Table 4.2. France has a much lower share of inpatient costs than the two other countries.

The disaggregation will now be advanced one further step. In the remainder of this chapter estimates on the distribution by main disease categories will be presented. Inpatient care (60 per cent of total costs in 1975) and outpatient care (20 per cent) are presented separately. There is no need for further disaggregating dental care (10 per cent), since dental care is usually referred totally to one category, diseases of the digestive system. It has not been possible to allocate drugs (*i. e.* drugs used outside hospital), eyeglasses, and other items (10 per cent).

Table 4.1. Composition of health care consumption in Sweden, 1964–1975. Current prices; percentages.

Type of service	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Hospital and other forms of inpatient care	49.2	50.0	52.4	53.3	55.7	55.7	59.0	57.7	58.0	57.5	59.3	60.0
Services of physicians and related practitioners	36.6	35.7	34.1	33.5	19.4	19.3	17.9	20.6	20.7	21.2	19.7	19.9
Dentists	–	–	–	–	11.8	11.9	11.1	10.4	10.0	9.7	9.9	9.5
Drugs	10.3	10.5	9.9	9.8	10.0	10.1	9.3	8.9	9.0	9.3	8.8	8.5
Therapeutic appliances and other items	3.9	3.8	3.6	3.4	3.1	3.0	2.7	2.4	2.3	2.3	2.3	2.1
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %

Source: Statistiska centralbyrån (1978).

Note: In the national accounts, outpatient care which takes place in hospital is referred to as hospital care. Here the figures are adjusted to the fact that about 50 per cent of the visits to physicians regards visits at hospital (Source: Socialstyrelsen, Allmän hälso- och sjukvård, various years). It is assumed that the costs per visit are the same in hospital as outside. This is, however, probably an underestimate, as the outpatient care at hospital tends to be more specialized.

Separate data for dentists are not available for 1964–1967. Instead they are included in the figures for physicians. Only a minor share of Public dental care is included in the figures for dental care in the national accounts. It has, however, been possible to estimate the expenditures for Public dental care, why these costs are here included in the total costs of dental care for 1968–1975 (Source: Socialstyrelsen, Allmän hälso- och sjukvård, various years, and Landstingsförbundet, LKELP, various years).

Table 4.2. Composition of health care consumption in France and the USA in 1973; percentages.

Type of service	France	USA
Hospital and other forms of inpatient care	41.5	52.8
Services of physicians and related practitioners	22.6	23.4
Dentists	9.9	7.0
Drugs	24.5	10.8
Therapeutic appliances and other items	1.5	6.0
Total	100 %	100 %

Source: Rösch and Sandier (1976).

The international classification of diseases

Before presenting the results of the estimated distributions of inpatient and outpatient care, a few words on the international (WHO) classification of diseases might be useful. The full names of the 17 main disease categories are given in Table 4.3, but they will be somewhat abbreviated in following tables and discussion.

The first main category, infective and parasitic diseases, includes diseases generally recognized as communicable or transmissible, *e. g.*, cholera, tuberculosis, diphtheria, whooping cough, poliomyelitis and syphilis, but excludes acute respiratory infections and influenza, which are both included in the eighth main disease category. The second main disease category includes all types of benign and malignant cancers as well as neoplasms of uncertain behaviour or nature. The third main category includes, *e. g.*, diabetes mellitus, various vitamin deficiencies, and gout. It excludes, however, endocrine and metabolic disturbances specific to the fetus and newborn, which are included in the fifteenth category.

Table 4.3. International statistical classification of diseases, injuries, and causes of death; main disease categories.

1. Infective and parasitic diseases
2. Neoplasms
3. Endocrine, nutritional and metabolic diseases and immunity disorders
4. Diseases of blood and blood-forming organs
5. Mental disorders
6. Diseases of the nervous system and sense organs
7. Diseases of the circulatory system
8. Diseases of the respiratory system
9. Diseases of the digestive system
10. Diseases of the genitourinary system
11. Complications of pregnancy, childbirth and the puerperium
12. Diseases of the skin and subcutaneous tissue
13. Diseases of the musculoskeletal system and connective tissue
14. Congenital anomalies
15. Certain conditions originating in the perinatal period
16. Symptoms, signs and ill-defined conditions
17. Accidents, poisonings, and violence

The fourth main disease category includes, *e. g.*, various anaemias and coagulation defects, but excludes anaemia complicating pregnancy or puerperium (eleventh category). Mental disorders include, *e. g.*, various psychoses, neurotic disorders, alcohol and drug dependence, and mental retardation. The sixth category includes, *e. g.*, meningitis, encephalitis, cerebral degenerations, Parkinson's disease, multiple sclerosis, epilepsy, glaucoma, cataract, and otitis media. The seventh category includes, *e. g.*, acute rheumatic fever, chronic rheumatic heart diseases, hypertensive heart diseases, ischaemic heart diseases, cerebrovascular diseases, varicose veins, and haemorrhoids.

The eighth main disease category includes, *e. g.*, the common cold, pneumonia, influenza, bronchitis, and asthma. The ninth category includes, *e. g.*, dental caries, gastric and duodenal ulcer, appendicitis, inguinal hernia, cirrhosis of liver, cholecystitis, and pancreatitis. The tenth category includes, *e. g.*, renal failure and other diseases of the urinary system, diseases of male genital organs, disorders of breast, and diseases of uterus and other female genital organs. The eleventh category includes various complications of pregnancy, childbirth, and the puerperium.

The twelfth main disease category includes, *e. g.*, eczema and psoriasis. The thirteenth category includes, *e. g.*, arthritis, rheumatism, and vertebral disc disorders. The fourteenth category includes congenital disorders, *e. g.*, spina bifida and Down's syndrome. The fifteenth category includes various conditions which have their origin in the perinatal period even though death or morbidity occurs later. The sixteenth category includes symptoms, signs, and ill-defined conditions. The seventeenth category, finally, includes all conditions due to accidents, poisonings, and violence.

The description above refers to the eighth revision of the international classification system, which came into effect in Sweden in 1969. Most of the changes due to that revision took place within the main categories. A few changes occurred, however, between categories. Before 1969, all allergies were included in the third main category; through the revision they were moved to categories 8, 9, 10, 12, and 13. The cerebrovascular diseases were moved from the diseases of the nervous system to diseases of the circulatory system. The fifteenth main category was previously used only for diseases of infants, but now it includes certain causes of perinatal morbidity and mortality, which used to be included in a separate supplement. Finally, among minor changes it may be mentioned that unspecified gastroenteritis was moved from diseases of the digestive system to infective and parasitic diseases in 1969. These changes must be kept in mind, while interpreting the results of the present study, since no attempt to take these changes into account have been made. Most of the data used are not so detailed that they permit such modifications.

It should also be noticed that the allocation by categories has been based on primary diagnosis, only. Ideally, some of the costs of treating a patient in hospital or of a physician visit should in many cases be referred to second or third diagnosis. This cannot be done at present, however, for lack of data. The absence of suitable data also makes

it impossible to estimate the size of the distortion caused by referring only to primary diagnosis.

Inpatient care

Data. In order to distribute the costs of inpatient care by disease categories, data for the Uppsala health care region in the middle of Sweden comprising 16 per cent of the Swedish population were used. Among other things these data give information on the total number of discharges and bed days during a year, distributed by main disease categories. All hospital stays in the Uppsala health care region during a year are covered. The data, which have been published by the Swedish National Board of Health and Welfare, do not cover all the years concerned but only 1964–1969, 1973, and 1975 and, moreover, only hospitals for somatic care. According to our estimates reproduced in Table 4.4 somatic care accounts for 65–75 per cent of the costs of inpatient care during this period of time. It should also be observed, that normal pregnancies are excluded from these data.

Estimating procedure. The percentage distributions found in the Uppsala material were considered to be representative for Sweden as a whole. The Uppsala region might, of course, be quite different from the rest of Sweden, making all comparisons at the national level impossible. Testing against the data for 1973 on the county of Skåne in the very south of Sweden, the only data published besides the data for the Uppsala region, makes plausible, however, the assumption that the Uppsala material is representative of Sweden, at least as far as the distribution of bed days is concerned. The two distributions of bed days by disease categories did not differ significantly in 1973 ($\chi^2 = 1.17$; 17 DFR).

The cost of a bed day varies between disease categories. Here it has been possible to use an investigation of per-day costs at different types of hospital departments in 1976 (Landstingsförbundet 1978), and so the different patterns regarding the departments used for treating different disease categories can be taken into account. The cost per day includes all the costs associated with the patient's stay in hospital, *i. e.*, the costs of physicians, surgeons, nurses, X-ray examinations, laboratory tests, *etc.*, are all included. There are no estimates of cost differences between diseases in the same type of hospital department available; the analysis must therefore be halted at this stage.

Table 4.4. Costs of inpatient care allocated to somatic and mental care, respectively, 1964–1975; percentages.

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Somatic care	66.5	66.9	67.0	69.4	68.9	69.9	70.3	71.7	72.3	72.9	73.7	74.0
Mental care	33.5	33.1	33.0	30.6	31.1	30.1	29.7	28.3	27.7	27.1	26.3	26.0
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %

Source: The estimates are based on the number of bed days in somatic and mental care, respectively (Source: Socialstyrelsen, *Enheten för hälso- och sjukvård*, various years), and the cost per bed day in somatic and mental care, respectively, in 1976 (Source: Landstingsförbundet (1978)).

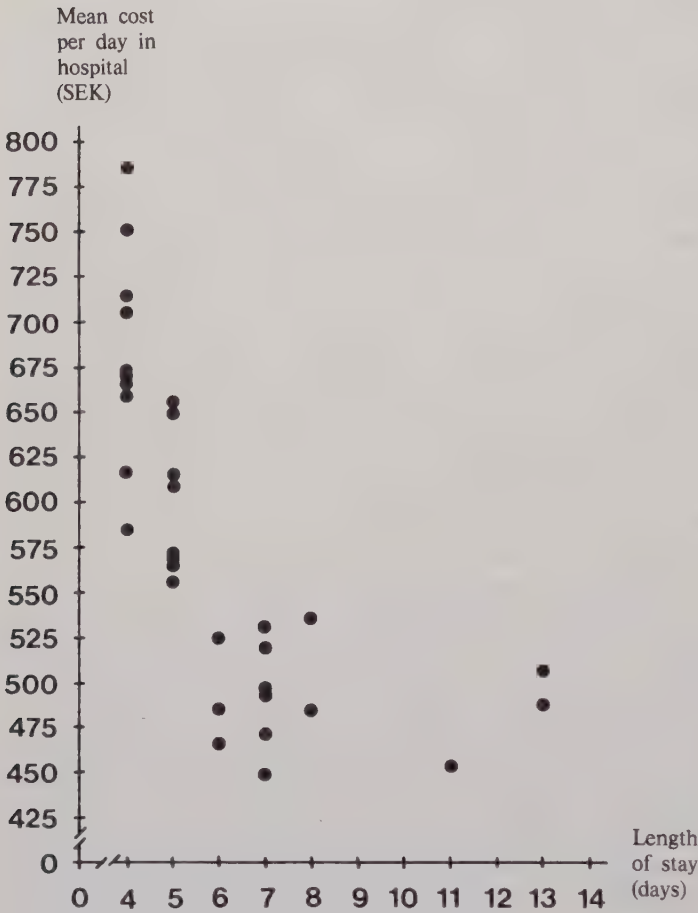
So, the estimated distributions of hospital costs for all years considered were based on the 1976 level of costs for bed days in different departments. There are, in practice, two ways to make the estimates. One way is to use the number of bed days as the measure of output, the other way is to use the number of treatments (discharges). In the first approach, using the 1976 level of cost of a bed day will tend to overestimate cost decreases which are due to shorter hospital stays. These will automatically raise the average cost per day for many treatments, since the very first few days in hospital are very expensive; the cost of one day in hospital towards the end of a patient's stay consists almost entirely of expenses for board and lodging and is considerably lower than the average cost. This is evident from those studies on the costs of a hospital stay which do not rely on per-day-cost accounting data but which attempt to estimate as far as possible the resource use actually caused by that hospital stay. An example may, for instance, be found in Lindgren *et al.* (1979). In Figure 4.1, reproduced from Lindgren *et al.* it appears that shorter stays are accompanied, as expected, by a higher average day cost. Feldstein (1967), Babson (1973), and Dahlberg (1977) report similar results.³ Furthermore, it is not always possible to reduce the length of stay without increasing the use of resources during the remaining days of hospital treatment. This explains why shorter stays may well mean unchanged or even increased cost per hospital stay.

Another reason for an overestimate of decreasing costs or an underestimate of increasing costs is the fact that physiotherapists, laboratory tests and other factor inputs might be used more intensively in 1976 than during previous years. In the second approach, using the 1976 level of cost of treatment will tend to underestimate cost decreases due to higher productivity. The only causes of cost decreases, following this approach, are (1) less treatments and (2) decreased use of departments with high costs per day. The "true" estimate will lie somewhere between these two measures.

Results. Table 4.5 presents the estimated distributions of hospital costs by disease categories, following the first approach, *i. e.* using bed days as the measure of output. The bed days in different disease categories are weighted according to the estimated average cost per bed day in each category; the weights are also given in Table 4.5.⁴ The unweighted distribution of bed days is given in Table 4.6. It does make a considerable change whether the differences in per-day cost are taken into account or not. For instance, diseases of the circulatory system account for a considerable smaller portion of hospital costs than of hospital days, because of the less than average bed day cost due to the fact that so many patients with these diseases are treated in less expensive long-term care units. The opposite is true for neoplasms, diseases of the digestive system, and accidents *etc.*; these categories have larger shares of hospital costs than of hospital days. In these cases the patients are often treated in highly costly surgical departments.

Remembering that mental hospitals and normal pregnancies are excluded, Table 4.5 says that neoplasms, diseases of the nervous system, diseases of the circulatory system, diseases of the musculoskeletal sys-

Figure 4.1. Mean cost per day in hospital, distributed according to the length of stay, for 32 gall-stone patients in the surgical department at Lund University Hospital, 1975 (from Lindgren *et al.* 1979) Comment: Length of stay refers to the net length, *i. e.* the day of admission and the day of discharge have each been counted as a half-day.



tem, and accidents *etc.* have large and increasing shares; that diseases of the respiratory system have large and fairly unchanged share; and that diseases of the digestive system and diseases of the genitourinary system have large but decreasing shares. The greatest relative decreases of shares can be found, however, among two of the smaller categories: infective diseases and complications of pregnancy. By looking at the data on which Table 4.5 is based, we can see that the decreasing shares depend both on decreasing shares of the number of treated and discharged patients and on decreasing mean lengths of stay. In the case of infective diseases, the decline is almost altogether a consequence of a considerable reduction of the mean length of stay, from 26.0 days in 1964 to 18.5 in 1969 and 11.5 in 1975. The developments of mean duration of hospital stay are given for all categories in Table 4.7. Besides

Table 4.5. Distribution of hospital costs by disease categories 1964-1969, 1973, and 1975, using number of bed days as output measure. 1976 level of cost; percentages.

Disease category	1964	1965	1966	1967	1968	1969	1973	1975	Cost per bed day in 1976, SEK
1. Infective and parasitic diseases	6.1	5.7	5.1	4.6	4.1	3.8	2.7	2.6	473
2. Neoplasms	10.0	10.1	10.5	10.7	10.5	10.6	10.8	11.4	526
3. Endocrine and metabolic diseases	4.5	4.2	4.0	4.1	4.1	4.1	4.3	4.3	428
4. Diseases of the blood	1.0	0.9	0.8	0.8	0.9	0.9	0.8	0.6	450
5. Mental disorders	1.5	1.6	1.9	1.5	1.6	2.0	2.8	2.2	344
6. Diseases of the nervous system	6.1	7.2	7.0	7.4	7.7	7.5	7.3	6.9	397
7. Diseases of the circulatory system	19.4	19.0	19.3	19.5	19.4	20.8	24.1	23.3	374
8. Diseases of the respiratory system	7.4	7.8	7.2	7.2	7.7	7.9	7.4	7.3	421
9. Diseases of the digestive system	9.5	9.3	8.9	9.3	9.1	8.8	7.6	7.3	596
10. Diseases of the genitourinary system	6.6	6.2	6.2	6.3	5.9	5.9	5.0	5.4	575
11. Complications of pregnancy and childbirth	3.0	2.9	3.2	3.2	2.8	2.3	1.4	1.2	649
12. Diseases of the skin and subcutaneous tissue	1.3	1.3	1.3	1.4	1.5	1.5	1.6	1.5	507
13. Diseases of the musculoskeletal system and connective tissue	6.1	5.7	6.3	6.1	5.9	6.7	5.9	6.6	434
14. Congenital anomalies	1.1	1.3	1.2	1.1	1.2	1.1	1.1	1.0	577
15. Certain causes of perinatal morbidity and mortality	0.8	0.9	1.0	1.0	0.9	0.7	0.7	0.7	514
16. Symptoms and ill-defined conditions	4.5	4.6	4.7	4.6	4.5	3.6	4.4	4.7	463
17. Accidents, poisonings and violence	9.8	10.6	11.0	10.7	11.5	11.1	10.8	11.4	519
18. All other	1.3	0.7	0.6	0.5	0.7	0.7	1.3	1.6	479
All categories	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	463

Note: This table is based on (1) data on bed days, distributed by disease categories (Source: Socialstyrelsen, Patientstatistik, various years) and (2) data on per-day costs at different types of hospital departments in 1976 (Source: Landstingsförbundet 1978).

Table 4.6. Bed days distributed by disease categories, 1964-1969, 1973, and 1975; percentages.

Disease category	1964	1965	1966	1967	1968	1969	1973	1975
1. Infective and parasitic diseases	5.8	5.5	4.8	4.2	3.8	3.6	2.6	2.4
2. Neoplasms	9.3	9.4	9.5	10.1	9.6	9.6	9.4	9.9
3. Endocrine and metabolic diseases	4.5	4.3	4.2	4.2	4.4	4.4	4.4	4.6
4. Diseases of the blood	1.1	0.9	0.8	0.8	0.8	0.9	0.7	0.7
5. Mental disorders	1.9	2.0	2.6	1.9	2.0	2.5	3.8	3.0
6. Diseases of the nervous system	6.2	7.6	7.5	8.2	8.4	8.3	8.0	7.5
7. Diseases of the circulatory system	23.6	23.2	23.3	24.1	24.2	25.9	29.2	27.8
8. Diseases of the respiratory system	7.8	8.2	7.5	7.4	7.9	7.9	7.7	7.9
9. Diseases of the digestive system	7.9	7.7	7.2	7.5	7.3	6.9	5.8	5.6
10. Diseases of the genitourinary system	5.7	5.3	5.2	5.2	4.8	4.8	4.0	4.3
11. Complications of pregnancy and childbirth	2.3	2.2	2.4	2.3	2.1	1.9	1.0	0.8
12. Diseases of the skin and subcutaneous tissue	1.2	1.2	1.2	1.3	1.3	1.3	1.4	1.4
13. Diseases of the musculoskeletal system and connective tissue	6.6	5.8	6.8	6.7	6.4	6.9	6.3	7.0
14. Congenital anomalies	0.9	1.1	1.1	0.9	1.0	0.9	0.8	0.8
15. Certain causes of perinatal morbidity and mortality	0.8	0.9	0.9	0.9	0.8	0.6	0.6	0.6
16. Symptoms and ill-defined conditions	4.3	4.4	4.5	4.3	4.2	3.2	4.2	4.6
17. Accidents, poisonings and violence	8.6	9.6	9.8	9.4	10.2	9.5	9.0	9.8
18. All other	1.5	0.8	0.8	0.4	0.7	0.6	1.2	1.4
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %

Source: Socialstyrelsen, Patientstatistik, various years.

Table 4.7. Mean length of stay in somatic hospitals for different disease categories, 1964–1969, 1973, and 1975; days.

Disease category	1964	1965	1966	1967	1968	1969	1973	1975
1. Infective and parasitic diseases	26.0	25.3	21.4	18.3	18.0	18.5	12.7	11.5
2. Neoplasms	19.4	18.7	17.5	18.3	17.5	19.2	18.7	17.1
3. Endocrine and metabolic diseases	18.4	17.5	17.6	17.3	19.1	20.8	20.7	19.9
4. Diseases of the blood	16.1	13.8	12.8	13.3	12.7	16.3	14.7	14.8
5. Mental disorders	24.1	25.5	29.7	22.8	26.9	33.0	58.2	44.2
6. Diseases of the nervous system	20.5	23.0	22.7	21.2	24.7	26.1	25.6	22.3
7. Diseases of the circulatory system	36.2	35.1	34.3	34.1	35.9	38.9	37.8	33.6
8. Diseases of the respiratory system	15.4	15.7	14.3	14.0	13.9	14.8	15.5	15.3
9. Diseases of the digestive system	10.8	10.6	10.1	10.1	10.1	10.2	10.1	9.9
10. Diseases of the genitourinary system	10.9	10.4	9.8	10.2	9.3	9.8	9.1	8.8
11. Complications of pregnancy and childbirth	7.2	6.9	6.7	6.6	6.3	6.2	4.7	4.5
12. Diseases of the skin and subcutaneous tissue	12.9	13.0	13.4	12.8	12.6	15.7	16.4	14.8
13. Diseases of the musculoskeletal system and connective tissue	25.1	22.6	25.2	25.5	24.2	25.5	24.0	23.0
14. Congenital anomalies	11.6	12.6	12.9	10.0	9.7	10.8	8.4	7.5
15. Certain causes of perinatal morbidity and mortality	16.3	16.9	16.5	16.3	14.8	13.2	10.8	9.4
16. Symptoms and ill-defined conditions	9.4	9.3	8.8	8.4	8.6	8.8	10.7	10.4
17. Accidents, poisonings and violence	17.2	17.9	20.0	16.8	17.9	17.4	17.0	16.2
18. All other	21.9	10.1	7.9	7.0	7.8	6.4	8.3	7.4
All categories	17.8	17.5	16.9	16.6	16.7	18.1	18.5	17.1

Source: Socialstyrelsen, Patientstatistik, various years.

Table 4.8. Distribution of hospital costs by disease categories 1964-1969, 1973, and 1975, using number of treatments (discharges) as output measure. 1976 level of cost; percentages.

Disease category	1964	1965	1966	1967	1968	1969	1973	1975	Cost per treatment in 1976, SEK
1. Infective and parasitic diseases	3.2	3.0	2.8	2.8	2.7	2.7	2.7	2.6	5,500
2. Neoplasms	11.0	11.2	11.6	11.4	11.4	11.4	10.6	11.2	8,400
3. Endocrine and metabolic diseases	4.3	4.2	4.1	4.1	4.0	3.8	4.0	4.2	7,800
4. Diseases of the blood	0.8	0.7	0.7	0.7	0.7	0.7	0.6	0.5	5,900
5. Mental disorders	2.6	2.4	2.6	2.3	2.3	2.3	2.5	2.4	15,100
6. Diseases of the nervous system	6.0	6.5	6.8	7.3	7.1	7.3	7.8	7.9	10,300
7. Diseases of the circulatory system	21.4	21.5	21.8	22.7	22.6	23.2	26.2	24.3	12,300
8. Diseases of the respiratory system	6.9	7.1	6.5	6.8	6.9	6.5	6.7	6.7	5,500
9. Diseases of the digestive system	10.0	9.9	9.2	9.2	9.2	9.2	7.4	7.0	5,200
10. Diseases of the genitourinary system	6.8	6.5	6.4	6.1	6.1	6.1	5.1	5.2	4,500
11. Complications of pregnancy and childbirth	2.4	2.3	2.4	2.3	2.2	2.2	1.4	1.2	2,800
12. Diseases of the skin and subcutaneous tissue	1.8	1.8	1.7	1.8	1.9	1.6	1.6	1.6	7,600
13. Diseases of the musculoskeletal system and connective tissue	5.6	5.4	5.5	5.3	5.5	5.9	6.0	6.6	9,500
14. Congenital anomalies	0.8	0.8	0.8	0.8	0.9	0.8	0.9	0.9	3,900
15. Certain causes of perinatal morbidity and mortality	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	2,900
16. Symptoms and ill-defined conditions	4.9	4.9	5.1	4.9	4.7	3.9	4.2	4.5	4,700
17. Accidents, poisonings and violence	9.7	10.4	10.6	10.2	10.5	10.9	10.2	10.7	7,600
18. All other	1.1	0.7	0.7	0.6	0.6	0.8	1.3	1.7	3,500
All categories	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	7,300

Note: This table is based on (1) data on treatments (discharges), distributed by disease categories (Source: Socialstyrelsen, Patientstatistik, various years), (2) data on per-day costs at different types of hospital departments in 1976 (Source: Landstingsförbundet 1978), and (3) data on bed days, distributed by disease categories in 1976 (Source: Socialstyrelsen, Patientstatistik 1976).

infective diseases, the average length of stay has been shortened for diseases of the genitourinary system, complications of pregnancy, congenital anomalies and certain causes of perinatal morbidity and mortality.

The general pattern of Table 4.5 does not change substantially, if the number of treatments (discharges) instead of the number of bed days is used as a measure of output, see Table 4.8. There are differences, in details, however, due to a different development of mean length of hospital stay for some categories.

From an economic point of view of the hospital system, the three most important categories were diseases of the circulatory system, neoplasms, and accidents. Had mental hospitals been taken into account, mental disorders would be among the four main categories. As can be seen in Table 4.4 mental disorders would, in fact, rank first; notice, too, the substantial decline in their share of inpatient costs between 1964 and 1975.

Outpatient care

Data. Unfortunately, there is no information available for more than one single year. Here, a study made by Berfenstam, Berg, and Smedby (1976) will be used, in which the distribution of all the visits to physicians in the Tierp district within the Uppsala health care region in April and May 1973 can be found. Only 0.25 per cent of the Swedish population lives in the Tierp district.

There are other sources available, however, but these cannot be used for a description of the development over years, since they do not cover the same population of study or because of other differences in scope and method.

Estimating procedure. The distribution of physician visits during April and May 1973 in the Tierp district was taken as representative of Sweden as a whole, since there seemed to be no alternative way of estimation available. Other studies were used in order to get an idea of the plausibility of the results, presented in Berfenstam, Berg, and Smedby (1976). In Medical Index Sweden, MIS, which was first published in 1979 by Läkemedelsstatistik AB and which will be published yearly in the future, the data on the distribution of visits are based on a sample of physicians from all parts of Sweden. Testing the hypothesis that the two distributions differ, leads to the result that the difference between MIS and the Tierp study is not statistically significant ($\chi^2 = 18.74$; 17 DFR).

It was further assumed that the cost of each physician visit is the same, including the costs of outpatient ancillary services. The distribution of costs of outpatient care will then be identical to the distribution of visits.

Results. The estimated distribution of outpatient costs is presented in Table 4.9. In 1973 the three main categories were diseases of the circulatory system, accidents, and diseases of the musculoskeletal system. The relatively great role played by the diseases of the respiratory system should also be observed.

Table 4.9. Distribution of visits to physicians in the Tierp district in 1973, by disease categories and sex, percentages.

Disease category	Men	Women	Both sexes
1. Infective and parasitic diseases	2.0	1.9	1.9
2. Neoplasms	1.4	1.6	1.5
3. Endocrine and metabolic diseases	2.6	3.5	3.0
4. Diseases of the blood	0.3	0.9	0.6
5. Mental disorders	3.1	3.6	3.4
6. Diseases of the nervous system	7.3	7.0	7.1
7. Diseases of the circulatory system	13.6	20.7	17.2
8. Diseases of the respiratory system	9.8	9.2	9.5
9. Diseases of the digestive system	4.5	5.1	4.8
10. Diseases of the genitourinary system	3.5	9.3	6.4
11. Complications of pregnancy and childbirth	—	0.5	0.2
12. Diseases of the skin and subcutaneous tissue	4.0	4.0	4.0
13. Diseases of the musculoskeletal system and connective tissue	14.2	10.5	12.3
14. Congenital anomalies	0.1	—	0.0
15. Certain causes of perinatal morbidity	—	—	—
16. Symptoms and ill-defined conditions	4.8	5.0	4.9
17. Accidents, poisonings and violence	19.2	8.1	13.6
18. All other	9.6	9.1	9.6
Total	100 %	100 %	100 %

Source: Berfenstam, Berg, and Smedby (1976).

Notes

- Most of the estimates presented in this and following three chapters have been published earlier in Hertzman and Lindgren (1980a) and in Lindgren (1981). Peter Hertzman's diligent research assistance is gratefully acknowledged.
- Drugs account for 3–4 per cent of hospital costs (*Source*: Socialstyrelsen, Allmän hälso- och sjukvård, various years).
- Normally, only average day cost is possible to identify in the accounting system of the Swedish hospitals. This fact may be one of the main factors behind the belief that early discharge from hospital might heavily reduce health care costs. There have been many studies on early discharge, and it is often asserted that a reduction of one day in the length of stay means a cost saving equivalent to the average cost of one day in hospital. For a discussion of this and four other common fallacies in estimating the economic gains of early discharge, see Jönsson and Lindgren (1980).
- See Chapter 3, note 7, for a description of the procedure followed in calculating the average cost per bed day in different disease categories.

5 Estimates of the total indirect costs of illness 1964–1975

The preceding chapters all dealt with the direct costs of the health care system. The *indirect* costs of illness are represented by the value of those goods and services that could have been produced had not a person fallen ill. The estimates of the indirect costs of illness in Sweden have been made separately for short-term illness, permanent disability, and premature death. The first section of this chapter deals with short-term illness, the next two sections with permanent disability and premature death, respectively. These indirect costs of illness will then be distributed as far as possible by disease categories in Chapter 6. Unfortunately, since the data do not permit any estimate of the distribution of the direct and indirect costs of illness for all the years concerned, we cannot do better than finally present an estimate of the total costs, distributed by disease category for one year, 1975. The estimates and some comparisons with other available studies will be presented in Chapter 7.

Short-term illness

Data. Each year the Swedish National Social Insurance Board publishes a volume of statistics ("Allmän försäkring"), which among other things breaks down the number of days on sickness benefit by age and sex. All Swedes in the productive ages are compulsorily registered with a local Social Health Insurance Agency, so the data cover the total population relevant here. These social insurance data were used to estimate the number of production years lost due to short-term illness. To convert the number of production years into a monetary figure, a study on average earned income for full-time working women and men, respectively in different age groups, was used. The study was performed by the Swedish National Bureau of Statistics.

Estimating procedure. Since there is a waiting period before sickness cash benefit is paid from social health insurance for every period of sickness, this waiting period, amounting to three days for the years 1964–1966 and one day for the years thereafter, was first added to the average number of sickness benefit days per period of sickness (*Source:* Riksförsäkringsverket, Allmän försäkring, various years). Next, this average number of "sick-days" (days lost through illness) per sickness period was multiplied by the total number of sickness periods, with breakdowns for age and sex (*Source:* Riksförsäkringsverket, Allmän

försäkring, various years). Since this total number of sick-days includes not only workdays, but normally weekends and holidays as well, it has been divided by 365 to arrive at the total number of working years lost. Lastly, the number of production years lost for each age group and sex has been multiplied by the average earned income, including all wage-cost markups for full-time working women and men in that age interval (*Source*: Statistiska centralbyrån 1979). In as much as such age-distributed income statistics are not available for more than a couple of years, I have invariably proceeded from the incomes earned in 1975. For earlier years the incomes have been estimated in each age interval and for each sex on the basis of an assumption about productivity and real wages rising at the rate of 3 per cent per annum, which is the average productivity increase in the Swedish economy during this period. Full employment was assumed, and the value of household production was considered to be equivalent to the average earned income in market production.

Results. Table 5.1 shows the estimated total production lost due to short-term illness. Between 1964 and 1975 the total production loss increased by an annual average of 6.4 per cent for both sexes taken together. One may say that 3 per cent of this percentage can be explained by our assumption about productivity increases in the economy. The remaining 3.4 per cent is explained by (1) an annual increase in lost production years averaging at 2.5 per cent; (2) the changing distribution of these years towards a higher proportion of men in the best paid years. The increase in the production loss is much greater for men than for women. The number of lost production years increased each year by 3.2 per cent for men, but only by 1.7 per cent for women. Expressed as production loss in terms of kronor, the increase came to 7.1 per cent for men and 5.4 per cent for women.

Discussion. It is here assumed that all persons between 16 and 66 years of age would have been engaged in some sort of productive work, either in a business firm, in a public agency or in the home, if they did not happen to fall ill. However, some sick people of able-bodied age would lack productive employment even if they were healthy. Sometimes, moreover, a sick person can be replaced by someone who would otherwise be unemployed. In both these cases the assumption made tends to overestimate the production loss. This overestimate is probably insignificant. At virtually any given moment in Sweden, the number of unfilled vacancies have exceeded the number of persons who are looking for work, which suggests that the registered unemployment has usually been more of a searching, frictional or structural character than a business-cycle phenomenon. As one implication of this, it is only by way of exception that a sick person can be replaced by a jobless person, and that is when the out-of-work has more or less the same knowledge and experience, lives in the same district and is willing to undertake that particular job. But note, too, that the assumption underestimates in those cases where old-age pensioners normally have some productive employment. In point of fact many retired persons have jobs, even outside the home.

It should also be observed that exactly the same value is attached

Table 5.1. Indirect costs of illness in Sweden, 1964-1975. Loss of production due to short-term illness, permanent disability, and premature mortality. 1975 prices and 4 per cent discount rate, million SEK.

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Short-term illness, men	5,723	6,255	6,720	7,215	7,772	9,336	9,709	10,060	9,948	10,523	11,223	12,158
Short-term illness, women	4,567	4,918	5,032	5,178	5,512	6,189	6,398	6,920	6,859	6,986	7,471	8,187
Permanent disability, full pension, men	2,219	2,903	4,179	4,270	4,551	5,855	6,493	8,559	10,314	10,584	9,153	9,165
Permanent disability, full pension, women	1,377	1,831	3,200	2,739	2,813	3,526	4,023	5,343	6,529	6,700	6,340	6,581
Permanent disability, partial pension, both sexes	400	526	820	779	818	1,042	1,169	1,545	1,872	1,920	1,722	1,799
Subtotal, morbidity	14,286	16,433	19,951	20,181	21,466	25,948	27,792	32,427	35,522	36,713	35,909	38,340
Expected loss of production, premature mortality, men	6,464	8,153	6,891	7,237	7,488	7,697	7,799	8,260	8,498	8,522	8,790	9,111
Expected loss of production, premature mortality, women	3,077	3,123	3,089	3,174	3,316	3,411	3,424	3,469	3,499	3,505	3,557	3,705
Subtotal, mortality	9,541	11,276	9,980	10,411	10,804	11,108	11,223	11,729	11,997	12,027	12,347	12,816
Grand total	23,827	27,709	29,931	30,592	32,270	37,056	39,015	44,156	47,519	48,740	48,256	51,156

Note: For lack of data, the indirect costs due to permanent disability for the years 1964, 1965, and 1967 have been estimated by a simple regression analysis with time as the only independent variable.

to different forms of housework as to the average market wage paid for an ordinary occupation. This is not an altogether unreasonable approximation even though it is not wholly unobjectionable. One may, for instance, argue that a person may benefit from participating in household activities up to a point where his marginal productivity is lower than in his market activities, since only income from market activities is taxed.

Note also that the market wage, including nonwage labour costs, has been consistently used to measure the size of the production loss. The value of the production turned out by a worker is roughly just as great as the wage for the marginal worker, the one who is last "hired". Although different forms of imperfections in the labour market can admittedly invalidate the resemblance to some extent, in most cases the wage makes a reasonably satisfactory approximate measure of the value of production.

Yet another complication lies in the fact that the increased labour inputs which results when illness falls off should normally cause the production value for each new man-hour to decline in accordance with the "law of diminishing returns". Our calculation is based instead on the assumption that the production value for each newly available man-hour is constant. That can be defended in part by saying that the resource usage would presumably increase marginally for all different types of uses if morbidity were to fall off. Be that as it may, our mode of calculation is bound to overestimate the production loss to some extent in any case. This can be offset in some measure by the underestimating tendency which surely arises when we calculate the effects of short-term absence. If a person is ordinarily a member of a gang, team, crew or the like, his absence on account of illness may also have effects on the productivity of his workmates, in which case the production loss will be greater than the wage.

As to the results, the increases in lost production years and in production losses cannot, obviously, be construed as increases solely because of increased morbidity in some sort of objective sense. There are of course no objective rules on how long a person needs to rest when recuperating. However, that is not unique as regards short-term illness. Such rules are also lacking when it comes to defining how much time is needed to care for a patient after surgery, and the post-operative period can of course influence the movement of the direct health-care costs. The increases in illness-related absence can be explained by several factors apart from increased morbidity *per se*. It can be contended, for instance, that since work in the private business sector demands ever better health of the employees, the criteria for being put on the sicklist with pay have become increasingly lenient. One can also contend that men and women themselves have become more and more inclined to take sick leave. This tendency may have been strengthened by the reforms that were implemented during the period here under review; as a result, the personal "deductible" or the loss of one's own income has become smaller because of reduced waiting period and elevated sickness cash benefits.

Permanent disability

Data. Permanent disability was equated with early retirement. Each year the Swedish National Social Insurance Board publishes statistics, broken down by age and sex, on newly granted early retirement pensions. Since not all such pensions take effect at the beginning of a year, but are spread across the whole year, a correction has to be made when the number of lost production years is calculated. The simplest and most usual method is to assume that the early retirements are pretty evenly spread over the year: hence the expected value is one-half year for each new retirement. However, the consequences of early retirement extend for many years ahead. Here allowance has been made for this by calculating the expected number of years which are left to retirement age for each new early retiree. For that purpose we used the life expectancy tables for 1970 made up by the Swedish National Bureau of Statistics (*Source:* Statistiska centralbyrån 1974). Lost production years were transformed into monetary units with the aid of the previously mentioned income data for 1975 (*Source:* Statistiska centralbyrån 1979).

Estimating procedure. The present value of future earnings for an early retiree was calculated separately for men and women and for different age groups, using the following assumptions. The income data for 1975 (*Source:* Statistiska centralbyrån 1979) were the initial data used. Bearing in mind the low rates of production and productivity growth in Sweden during the past decade, we have let our calculations postulate that there will be no increase in productivity within the foreseeable future. Further, all future production losses have been discounted by 4 per cent.² Some of the subsequent tables will show how the estimate of the indirect costs is affected if 2.5 or 10 per cent was used instead for discounting purposes. The following formula was used:

$$V_a = \sum_{n=a}^{66} \frac{P_{an} W_n}{(1+i)^{n-a}} \quad (\text{Eq. 5.1}),$$

where V is the present value, a is the age of the one who is retiring early in current year, P_{an} is the probability that a person of a years will live till he is n years old, W_n is the average earned income of persons who have reached the age of n , and i is the discount rate. Five-year intervals have been separately calculated for men and women. They both have different survival probabilities and different earned incomes. (*Sources:* Statistiska centralbyrån 1974 (for data on survival probabilities) and Statistiska centralbyrån 1979 (for data on earned incomes broken down by age and sex).)

This present value was then multiplied by the number of early retirees in the relevant age and sex group and summed.³

Results. The production loss estimated in consequence of early retirement is also shown in Table 5.1. All in all, that loss is estimated to have increased by an average 14.7 per cent per annum between 1964 and 1975. The increase is somewhat greater for women (15.3 per

cent) than for men (14.3 per cent). The assumption of rising productivity accounts for 3 per cent of the increase. The remainder of the increase is almost exclusively due to a higher incidence of early retirement. An altered age structure could have been yet another explanatory factor. If early retirement had taken place at ever younger ages, the expected production loss per early retirement would have been greater. However, the age structure of new early retirees tends to change in the opposite direction: the older age groups increase their shares.

Discussion. The fact that the number of early retirements has increased is not solely due to an actual increase in the number of disabled persons, even if the population's altered age mix may be a contributory factor. On the contrary, there is a great deal of evidence to suggest that many of the factors making for disability have diminished in importance. Fewer occupational injuries are sustained and road accidents are on the wane. Polio, which used to cripple so many people when they were young, has been virtually eliminated.

One explanation for the upturn in early retirements may have to do with changes in the labour market: some handicaps are increasingly construed to be of a nature which rules out the performance of work tasks. Also important are the easier official rules defining eligibility for advance superannuation and the lifted pension amounts that went into effect during the latter part of the time period studied here. In 1970 it also became possible to combine labour-market considerations with medical reasons for persons who were at least 63 years old. Came 1972, and the requirement for this age group to state medical reasons was dropped, and in 1974 the age limit for early retirement on non-disability grounds was lowered to 60. The size of the pension has been raised as well: in terms of constant prices it was admittedly unchanged in 1964–69, but it has risen in every year since 1970. So far, to be sure, labour-market reasons alone have not been so much invoked as grounds for early retirement, but one can suspect that the more lenient attitude may have reinforced the tendency to retire early by stating medical reasons; for a detailed discussion, see Wadensjö (1980). However, it should also be noted that the estimate does not include those persons who retire early by stating labour market considerations. Note, too, that the annual increases in the production loss are greater before 1970 (21.1 per cent) than after 1970 (9.0 per cent).

Finally, it should be noticed that each early retirement was assumed to be due to a *permanent* disability. Obviously, this denotes an over-estimation in those cases where the retiree returns to productive life. Of all those who retired early during the time period studied here, advance superannuation was terminated for only a smaller number, around 1,500 persons each year, because they went back to work (Wadensjö 1980). Since this figure accounts for 0.5–1 per cent of all early retirees, the overestimate should be moderate.

Mortality

Data. Data on mortality were taken from various issues of "Dödsorsaker" ("Causes of Mortality"), published yearly by the Swedish Na-

tional Bureau of Statistics. The sources for incomes and for survival probabilities were the same as those used to calculate the production lost on account of permanent disability, see above.

Estimating procedure. Here the same method was used as in calculating the expected production loss due to permanent disability.

However, some of the persons who die in the course of one year before reaching the age of 67 are early retirees, more specifically 6 000–7 000 such pensioners a year during the time period under review here, which comes to 2–4 per cent of all those in receipt of early retirement pensions at the beginning of the year (Wadensjö 1980). Double-counting will readily arise unless we adjust downward either the estimated production loss due to early retirement or the loss due to early death. Here, the death was seen as the reason for the production loss, a choice which facilitated the classification into main disease categories. If a person is pensioned off early in one year and later dies during that same year, the production loss in its entirety was counted as a mortality cost. If the person dies one year later, the production loss was counted in principle as one year's morbidity cost and the remainder as mortality costs.

The risk of death is much higher for the groups of persons who have got disability pensions, see Table 5.2. The higher mortality rates of the permanently disabled have been used in doing the mentioned adjustment to avoid double-counting. The estimate of the production loss on account of permanent disability turns out 11 per cent lower than it would have been without this adjustment.

Results. According to Table 5.1 there is a rather weak but stable increase in the expected production loss attributable to early death among women. The increase is approximately 1.7 per cent per annum between 1964 and 1975. It does not stem from higher mortality – on the contrary, the number of lost production years fell off by about 1.9 per cent a year – but from the fact that every lost production year had a rising value (3 per cent a year). The production loss expected among men takes a more irregular trend, this because mortality and with that the number of lost production years have sometimes risen, sometimes fallen, during the time period studied. However, the expected number of lost production years in 1975 was around 6.0 per cent less than in 1964, which points to an annual decrease of 0.6 per cent. Even so, the expected value of lost production rose by about 3.2 per cent a year.

Table 5.2. Risks of death for the Swedish population at large and for permanently disabled persons, respectively, by age (17–67 years) and sex.

Age	Men		Women	
	Total pop- ulation	Permanently disabled	Total pop- ulation	Permanently disabled
17	0.0007	0.0053	0.0005	0.0059
18	0.0011	0.0056	0.0006	0.0060
19	0.0012	0.0059	0.0004	0.0061
20	0.0012	0.0062	0.0004	0.0062
21	0.0011	0.0064	0.0004	0.0063
22	0.0011	0.0067	0.0006	0.0064
23	0.0010	0.0070	0.0005	0.0065
24	0.0011	0.0074	0.0005	0.0066
25	0.0007	0.0077	0.0005	0.0067
26	0.0013	0.0081	0.0005	0.0069
27	0.0012	0.0084	0.0006	0.0070
28	0.0012	0.0088	0.0005	0.0072
29	0.0013	0.0092	0.0005	0.0074
30	0.0015	0.0096	0.0006	0.0075
31	0.0015	0.0100	0.0006	0.0077
32	0.0013	0.0105	0.0005	0.0079
33	0.0013	0.0110	0.0008	0.0082
34	0.0015	0.0114	0.0008	0.0084
35	0.0016	0.0119	0.0010	0.0086
36	0.0017	0.0125	0.0009	0.0089
37	0.0018	0.0130	0.0013	0.0092
38	0.0017	0.0136	0.0013	0.0095
39	0.0018	0.0142	0.0011	0.0098
40	0.0023	0.0148	0.0018	0.0101
41	0.0027	0.0155	0.0011	0.0105
42	0.0027	0.0162	0.0016	0.0109
43	0.0027	0.0169	0.0021	0.0113
44	0.0033	0.0176	0.0020	0.0117
45	0.0037	0.0184	0.0022	0.0122
46	0.0033	0.0192	0.0022	0.0126
47	0.0041	0.0200	0.0025	0.0132
48	0.0045	0.0209	0.0028	0.0137
49	0.0050	0.0218	0.0034	0.0143
50	0.0055	0.0227	0.0038	0.0149
51	0.0061	0.0237	0.0037	0.0156
52	0.0068	0.0247	0.0039	0.0163
53	0.0071	0.0258	0.0045	0.0170
54	0.0077	0.0269	0.0046	0.0178
55	0.0082	0.0281	0.0050	0.0187
56	0.0096	0.0293	0.0052	0.0196
57	0.0110	0.0305	0.0055	0.0205
58	0.0111	0.0318	0.0067	0.0215
59	0.0120	0.0332	0.0068	0.0226

Age	Men		Women	
	Total pop- ulation	Permanently disabled	Total pop- ulation	Permanently disabled
60	0.0146	0.0348	0.0082	0.0238
61	0.0159	0.0361	0.0086	0.0250
62	0.0169	0.0377	0.0094	0.0263
63	0.0190	0.0393	0.0105	0.0277
64	0.0222	0.0410	0.0118	0.0291
65	0.0231	0.0427	0.0132	0.0307
66	0.0256	0.0445	0.0144	0.0324
67	0.0290	0.0464	0.0160	0.0341

Sources: Statistiska centralbyrån (1974; for total population) and Riksförsäkringsverket (1978; for permanently disabled).

Calculation of production loss due to permanent disability or early death. An example

Every time a person retires or dies early, some future production is forgone. This loss may be calculated by means of the formula:

$$V_a = \sum_{n=a}^{66} \frac{P_{an} W_n}{(1+i)^{n-a}} \quad (\text{Eq. 5.1}),$$

where V is the expected present value of future incomes, a is the age of the person who is retiring early or dying a premature death in the current year, P_{an} is the probability that a person of age a will live till he is n years old, W_n is the average earned income (including nonwage labour costs) of persons working full time who have reached the age of n , and i is the discount rate. An example will show how the calculations were performed.

In 1975 fifty-four men in the 35–39 age group died of diseases of the circulatory system. For each of them a maximum 27–31 productive years remained. During this time the individual would have had different earned incomes and different survival probabilities, for which we shall make allowance in the calculation. In so doing we have chosen to use five-year intervals because that is the lowest level for which statistics on mortality and early retirement that are diagnosis-related can be obtained.

Table 5.3 sets out the basis for calculating the present value of future earned income for a man in the 35–39 age interval. Multiplying the number of production years in the age interval (column 1) by the survival probability (*Source*: Statistiska centralbyrån 1974) for the same age interval (column 2) gives the average number of earning years per person

Table 5.3. Calculation of the present value of future earned incomes for a man in the 35-39 age interval. (Thousands of kronor).

Age (1)	Probability that a 37 year-old man will reach age of n (P_{an}) (2)	Number of productive years per person (3)	Average earned income per year (W_n) (4)	Total income (5)	Discounting factor			Discounted total income		
					2.5 % (6)	4 % (7)	10 % (8)	2.5 % (9)	4 % (10)	10 % (11)
35-39	1.000	2.50	75.8	189.5	0.970	0.962	0.888	183.8	182.3	168.3
40-44	0.990	4.95	75.8	375.2	0.884	0.882	0.621	331.7	308.4	233.0
45-49	0.974	4.87	77.4	376.9	0.781	0.676	0.386	294.4	254.8	145.5
50-54	0.950	4.75	77.4	367.7	0.690	0.555	0.239	253.7	204.1	87.9
55-59	0.913	4.57	72.7	332.2	0.610	0.456	0.149	202.6	151.5	49.5
60-64	0.855	4.28	72.7	311.2	0.539	0.375	0.092	167.7	116.7	28.6
65-66	0.797	1.59	72.7	115.6	0.495	0.327	0.066	57.2	37.8	7.6
Total	-	27.51	-	2,068.3	-	-	-	1,491.1	1,255.6	720.4

in that age interval (column 3). In the first age interval the probability is 1, which has to be multiplied by 2.5. *i. e.* the average number of production years in the age interval. Next, the number of earning years is multiplied by the average yearly income (column 4, *Source*: Statistiska centralbyrån 1979), after which the total expected income in the age interval is obtained (column 5). The next step is to add up the expected incomes in each age interval, which gives the total expected future incomes for a 37-year-old man. For a man in the 35–39 age interval the expected average life income of SEK 2,068,000 is received for an average 27.5 years of work.

But then no allowance has been made for the lower value that will be attached to goods and services acquired farther on in time. Shown in columns 6–8 are the discounting factors when the rates are 2.5, 4 and 10 per cent, respectively. The discounting factors get lower and lower the more remote the income is. That tendency is reinforced if a higher discount rate is chosen. The total earned income in each age interval is multiplied by the discounting factor to give the discounted income in that age interval (columns 9–11). Adding up these incomes for each age interval gives us the present value of the expected future incomes for a 37-year-old man (or a man in the 35–39 age interval). When the discount rate is 2.5 per cent the present value will be SEK 1,491 thousand, with a rate of 4 per cent it is SEK 1,256 thousand, and with 10 per cent the present value is SEK 720.4 thousand. Since there are 54 men in the 35–39 age interval in our example, the total production loss with a 2.5 per cent discount rate is SEK 80.5 million, with a 4 per cent rate SEK 67.8 million, and with a 10 per cent rate SEK 38.9 million.

A table of this kind has been constructed for all age groups, both men and women. Thus, in order to calculate the total production loss due to early death, a total of 28 tables of the kind described here were used. Figures 5.1 and 5.2 show the results of these calculations in condensed form. They show how the present value of expected future incomes varies with the age of men or of women, as the case may be. It will be seen that at first the present value increases with age and reaches its maximum in the 20–25 age interval for both men and women. We can also see how the choice of a higher discount rate leads to a considerably lower present value for the younger age groups, but that the difference of present value which comes from using three different discount rates diminishes with rising age.

Some concluding remarks

The calculations of how the total indirect costs of illness have developed can now be summarized. As pointed out, there are tendencies towards both underestimation and overestimation. It is hard to form any definite opinion about the extent to which these tendencies cancel each other out. Besides, two more reasons for underestimation may be worth noticing. The one is when a person with temporarily impaired working

Figure 5.1. Present value of expected future income at different ages, 1975. Discount rates: 2.5, 4, and 10 per cent. Men.

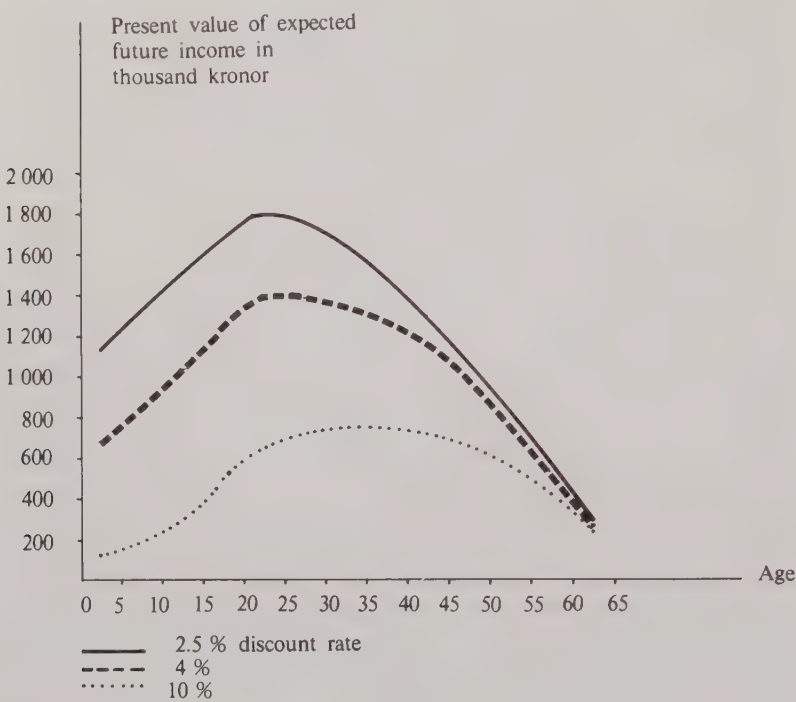


Figure 5.2. Present value of expected future income at different ages. Discount rates: 2.5, 4, and 10 per cent. Women.

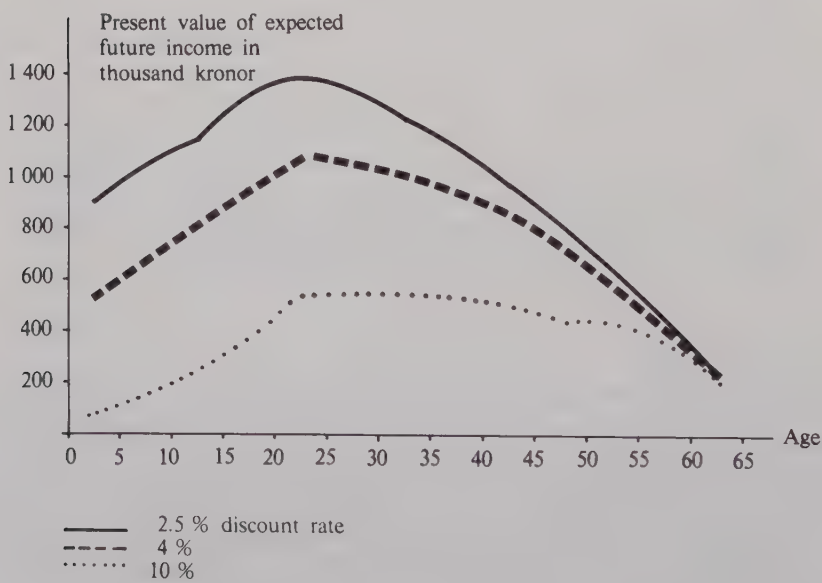


Table 5.4. Indirect costs of illness, 1964–1975. Loss of production due to short-term illness, permanent disability, and premature mortality, both sexes. 1975 prices and 4 per cent discount rate, percentages.

	1964	1965	1966	1967	1968	1969
Short-term illness	43.2	40.3	39.4	40.4	41.1	41.9
Permanent disability	16.8	19.0	27.4	25.5	25.4	28.1
Premature mortality	40.0	40.7	33.3	34.1	33.5	30.0
Total	100 %	100 %	100 %	100 %	100 %	100 %

	1970	1971	1972	1973	1974	1975
Short-term illness	41.2	38.4	35.4	35.9	38.7	39.8
Permanent disability	30.0	35.0	39.4	39.4	35.7	35.2
Premature mortality	28.8	26.6	25.2	24.7	25.6	25.0
Total	100 %	100 %	100 %	100 %	100 %	100 %

Source: Table 5.1.

incapacity due to illness still does not report sick. The other is when a person whose working capacity is more permanently impaired by illness switches to a lighter job, one that is perhaps less well-paid. Both these reasons may have some importance even though their quantitative impact is hard to determine.⁴

All the same, the risks of making excessive overestimates or underestimates seem to be small. Not only that, but any misestimate has its greatest importance when it refers to the size of a production loss in a specific year. For purposes of analysing percentage changes of the production loss over time, any misestimates do not matter very much provided that their underlying causes are not materially changed. Nor do they make much difference to the calculation of the relative distribution of the indirect costs by disease categories, a matter to which we return in Chapter 6.

According to the calculations, the total indirect costs turn out to be rather substantial, amounting to slightly more than SEK 50,000 million in 1975 using the 4 per cent discount rate for future production losses consequent upon permanent disability and premature death. The increase per annum from 1964 to 1975 averages at 7.2 per cent in constant (1975) prices. This is a doubling of the indirect costs of illness during the period 1964–1975. As will be seen from Table 5.4, the different patterns taken by the three types of indirect costs give them wholly dissimilar weights in the overall measure during different years. Thus the mortality cost represents 40 per cent of the production loss in 1964 but only 25 per cent in 1975.

1. This somewhat underestimates the number of working years lost, since short-term illness is probably more frequent during work-days than during holidays and vacations. However, no better approximation is available.
2. The discounting is to reflect time preferences or opportunity cost of capital but *not* inflation. Constant prices are used in all the estimates.

It should be noticed, too, that the discount rate can be adjusted to take expected changes in labour productivity into account. For instance, a 6-percent discount rate adjusted for an annual 2-percent rise in labour productivity will yield an effective discount rate of approximately 4 per cent. So, even if an annual 2-percent rise in labour productivity and a 6-percent (time-preference) discount rate were considered to be more appropriate assumptions than zero growth and a 4-percent (time-preference) discount rate, the estimates based on the latter assumptions could still be used.

3. It should be noticed that the estimate of the production loss due to permanent disability is based on future losses resulting from morbidity (prevalence) in a specific year and *not* on future morbidity that may arise from disease that has its onset (incidence) in that year. The onset of the disease may well have occurred in a previous year. The estimate is, thus, based on the prevalence, and not on the incidence, of the disease. See, also, Rice and Hodgson (1981), p. 37.
4. Bartel and Taubman (1979) have analysed eight different diseases for their short-term and long-term effects on wages and number of hours worked in the United States. All the effects were measured in 1973, while the diagnosed onset of the diseases was recorded in five earlier periods: before 1948, 1948–1954, 1955–1961, 1962–1967 and 1968–1973. The researched population consists of white male twins born in the US between 1917 and 1927. Ill health visited rather pervasive effects on the persons entering into the investigation (obviously, the control group consists of those twins who were not struck by illness) during 1962–1967. On an average an individual's earned income fell of in 1973 by 1.3 per cent for each additional disease diagnosis that was determined during 1962–1967. For some diseases such as arthritis and bronchitis, the result was to reduce earned income by as much as 20–30 per cent. The reductions are attributable both to lower wages per hour worked and a smaller number of man-hours. To exemplify with arthritis, as much as 78 per cent of reduced incomes are explained by the former cause and a mere

22 per cent by the latter. On the other hand, the lower hourly wage accounts for only 58 per cent but the reduced number of man-hours for as much as 42 per cent of the lower income earned by victim of bronchitis.

6 Estimates of the indirect costs distributed by type of cost and by disease category

The estimated indirect costs of illness, the development of which was described in Chapter 5, will now be apportioned among disease categories.¹ Calculations of the production loss in consequence of short-term illness, permanent disability and premature death will each be treated separately. A discount rate of 4 per cent will be consistently used to calculate lost future production in this chapter.

Short-term illness

Data. The Swedish Social Insurance Board has published breakdowns of short-term illness into disease categories, but unfortunately for only two years, 1966 and 1970 (Riksförsäkringsverket 1968 and 1974). These data are based on a sample of persons who are covered by the compulsory scheme of national health insurance, *i.e.* all registered persons born on the 15th of any month in the year, comprising around three per cent of the Swedish population. The data cover all the reported periods of sickness during the year for this sample of persons. A diagnosis is always reported and noted. For periods of sickness less than six days, the reported illness may be based on either a self diagnosis or a doctor's diagnosis; for periods of sickness lasting for six days or more, doctor's examination of the patient is necessary for receiving sickness cash benefit.

Estimating procedure. The estimated total indirect costs due to short-term illness presented in Chapter 5 were distributed by main disease categories on the assumption that the 3 per cent sample is representative of the total Swedish population. The production loss for each person in the sample was calculated in the same way as for the total costs due to short-term illness. The method was described in Chapter 5.²

Results. Table 6.1 presents the results of the calculations. The four most important categories for men in 1966 are diseases of the musculoskeletal system and connective tissue; accidents, poisoning and violence; mental disorders; and diseases of the digestive system. These same categories still accounted for heavy percentages in 1970, but diseases of the respiratory system had increased sharply and by then had moved up to second place. For women the four most important disease categories in 1966, as far as their effects on production were concerned,

Table 6.1. Distribution of lost production due to short-term illness by disease categories and sex 1966 and 1970, percentages. 1975 prices and 4 per cent discount rate.

Disease category	Men		Women		Total	
	1966	1970	1966	1970	1966	1970
1. Infective and parasitic diseases	2.4	3.3	2.8	3.6	2.6	3.4
2. Neoplasms	2.2	1.9	4.0	4.0	3.0	2.7
3. Endocrine and metabolic diseases	2.1	1.0	2.8	1.7	2.4	1.3
4. Diseases of the blood	0.4	0.2	1.9	1.1	1.0	0.6
5. Mental disorders	11.0	11.0	12.8	12.2	11.7	11.6
6. Diseases of the nervous system	6.2	3.9	4.6	3.5	5.5	3.7
7. Diseases of the circulatory system	9.8	8.5	8.7	7.3	9.3	8.1
8. Diseases of the respiratory system	9.7	16.5	10.4	20.0	10.0	18.1
9. Diseases of the digestive system	10.5	9.8	7.3	6.7	9.1	8.6
10. Diseases of the genitourinary system	2.2	1.8	8.9	6.9	5.1	3.8
11. Complications of pregnancy and childbirth	—	—	2.7	2.1	1.2	0.8
12. Diseases of the skin and subcutaneous tissue	1.5	1.4	1.5	1.4	1.5	1.4
13. Diseases of the musculoskeletal system and connective tissue	21.4	23.8	15.8	17.9	19.0	21.7
14. Congenital anomalies	0.3	0.1	0.2	0.1	0.3	0.1
15. Certain causes of perinatal morbidity and mortality	—	—	—	—	—	—
16. Symptoms and ill-defined conditions	4.8	3.1	6.2	4.0	5.4	3.5
17. Accidents, poisonings and violence	15.5	13.7	9.4	7.5	12.9	11.9
Total	100%	100%	100%	100%	100%	100%

Note: The calculation only includes persons between 20 and 66 years of age.

were diseases of the musculoskeletal system and connective tissue, mental disorders, diseases of the respiratory system and accidents, violence and poisonings. These same categories continued to rank highest in 1970. Their rank-order had changed, however: diseases of the respiratory system moved from third to first place. On the whole men and women show the same patterns both as regards which categories dominate the short-term sicklistings and as regards the development between 1966 and 1970. Striking differences in the percentages for men and women are shown only by diseases of the musculoskeletal system and connective tissue and by injuries due to violence and poisoning, which are two categories where men have higher percentages.

Permanent disability

Data. The Swedish Social Insurance Board has presented data on all new early retirements for 1966 and for every year beginning with 1968, where the cause of such retirement is identified by reference to disease category. These data are used here to apportion the total costs of the production that is lost due to permanent disability.³

Estimating procedure. The method of calculation was described in Chapter 5.

Table 6.2. Distribution of lost production due to permanent disability by disease categories 1966 and 1968-1975. 1975 prices and 4 per cent discount rate. Men, percentages.

Disease category	1966	1968	1969	1970	1971 /	1972	1973	1974	1975
1. Infective and parasitic diseases	3.6	2.7	2.7	2.2	2.1	1.9	1.5	1.6	1.7
2. Neoplasms	2.9	2.6	2.2	2.2	2.7	2.3	2.3	2.1	2.4
3. Endocrine and metabolic diseases	4.6	4.6	4.3	4.2	2.8	2.6	2.3	2.4	2.6
4. Diseases of the blood	0.4	0.3	0.5	0.3	0.1	0.1	0.2	0.1	0.1
5. Mental disorders	34.1	34.5	34.9	34.6	27.9	29.4	30.1	28.5	25.5
6. Diseases of the nervous system	11.3	10.4	10.5	10.0	6.2	6.0	4.9	5.0	5.1
7. Diseases of the circulatory system	15.5	15.0	14.3	13.9	19.5	19.1	19.6	20.7	21.1
8. Diseases of the respiratory system	1.8	2.0	2.1	2.1	4.5	4.2	4.1	4.0	4.2
9. Diseases of the digestive system	1.2	1.5	1.6	1.5	1.5	1.8	1.6	1.7	1.9
10. Diseases of the genitourinary system	0.8	0.8	0.8	0.9	0.6	0.7	0.6	0.6	0.5
11. Complications of pregnancy and childbirth	-	-	-	-	-	-	-	-	-
12. Diseases of the skin and subcutaneous tissue	0.4	0.3	0.4	0.4	0.6	0.6	0.6	0.6	0.6
13. Diseases of the musculoskeletal system and connective tissue	16.0	18.4	18.8	20.7	25.7	25.4	26.9	27.3	28.4
14. Congenital anomalies	1.0	0.5	0.6	0.6	0.6	0.7	0.6	0.7	0.6
15. Certain causes of perinatal morbidity and mortality	-	-	-	-	-	-	-	-	-
16. Symptoms and ill-defined conditions	2.6	2.2	2.0	2.2	0.7	0.7	0.5	0.5	0.5
17. Accidents, poisonings and violence	3.8	4.2	4.3	4.2	4.5	4.5	4.2	4.2	4.8
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %

Note: The sixteenth disease category here includes all diseases which cannot be allocated to any other disease category.

Table 6.3. Distribution of lost production due to permanent disability by disease categories 1966 and 1968-1975, 1975 prices and 4 per cent discount rate. Women, percentages.

Disease category	1966	1968	1969	1970	1971	1972	1973	1974	1975
1. Infective and parasitic diseases	3.6	2.3	2.1	2.6	2.3	2.0	1.8	1.5	1.5
2. Neoplasms	2.9	4.3	3.8	3.7	4.5	3.7	4.1	4.1	4.7
3. Endocrine and metabolic diseases	4.6	5.6	5.0	5.5	3.8	3.6	3.1	3.3	3.5
4. Diseases of the blood	0.4	0.3	0.8	0.3	0.2	0.2	0.2	0.2	0.3
5. Mental disorders	34.0	35.8	37.0	35.5	30.1	30.5	29.2	27.6	25.7
6. Diseases of the nervous system	11.3	10.2	10.6	10.2	6.9	7.1	5.7	5.6	5.5
7. Diseases of the circulatory system	15.6	10.8	9.7	9.4	12.9	12.7	13.0	12.8	12.5
8. Diseases of the respiratory system	1.8	1.0	0.9	0.9	3.4	3.3	3.2	3.3	3.5
9. Diseases of the digestive system	1.2	1.4	1.3	1.3	1.4	1.6	1.6	1.7	1.7
10. Diseases of the genitourinary system	0.8	1.1	1.3	1.2	1.0	1.1	1.0	0.8	0.7
11. Complications of pregnancy and childbirth	-	-	-	-	-	-	-	-	-
12. Diseases of the skin and subcutaneous tissue	0.4	0.6	0.7	0.7	0.7	0.7	0.8	0.9	1.1
13. Diseases of the musculoskeletal system and connective tissue	16.0	20.4	20.5	22.9	27.6	28.6	31.5	33.3	33.9
14. Congenital anomalies	1.0	1.2	1.4	1.1	1.5	1.4	1.5	1.4	1.4
15. Certain causes of perinatal morbidity and mortality	-	-	-	-	-	-	-	-	-
16. Symptoms and ill-defined conditions	2.6	2.4	2.5	2.5	1.0	0.8	0.6	0.7	0.8
17. Accidents, poisonings and violence	3.8	2.6	2.4	2.2	2.7	2.7	2.7	2.8	3.2
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %

Note: See Table 6.2.

Results. Tables 6.2 and 6.3 show the respective breakdowns for men and women. The three most important categories for both sexes were diseases of the musculoskeletal system and connective tissue, mental disorders and diseases of the circulatory system. Diseases of the musculoskeletal system rose steeply for both men and women, while mental disorders plummeted. Mental disorders dominate right up to the most recent years. That is not *ipso facto* because this disease category has the highest proportion of early retirees, but reflects the many young people who are pensioned off early with mental disorders as the stated reason. These carry greater weight for purposes of calculating the production loss. The percentage of persons who retire early because of circulatory disorders shows great variations, a fact that is also reflected in these diseases' share of the production loss.

Note the big decline for diseases of the nervous system: from 11.3 to 5.1 per cent for men and from 11.3 to 5.5 per cent for women. It may also be worth noting that neoplasms do not show any determinately rising share.

Mortality

Data. Detailed data on all deaths and their distribution among different diseases are published by the Swedish National Central Bureau of Statistics each year in a volume called "Dödsorsaker" ("Causes of Mortality"). These data form the base for calculating the distribution of expected production loss in consequence of early death.

Estimating procedure. The method of calculation was described in Chapter 5.

Results. The results are presented in Tables 6.4 and 6.6. It appears from Table 6.4 that injuries due to violence and poisoning contribute most to the production loss where men are concerned; not only that, but this category has increased its share since 1964. Next come diseases of the circulatory system; this category's share has also increased even after allowance is made for the change in the classification system. Neoplasms come in third place, but this category shows an approximately unchanged share. Diseases of the digestive system show a slight increase and their share in 1975 was the fourth largest. The sharp downturn in the percentage for certain causes of perinatal mortality should also be noted; this category's share decreased gradually even before the change in the classification system in 1969.

Table 6.4 sets out the percentage distribution of the expected production loss. This is affected by various factors, notably the choice of discount rate. The higher the rate, the less weight that will be attached to deaths in young years in this type of estimates. If instead we figure out the distribution of lost production years without giving the years different weights according to age at time of death, we get Table 6.5. It has essentially the same features as Table 6.4. The same categories dominate and their rank-orders are the same, too. However, injuries due to violence and poisoning are up slightly, whereas diseases of the

Table 6.4. Distribution of lost production due to premature mortality by disease categories, 1964-1975. 1975 prices and 4 per cent discount rate. Men, percentages.

Disease category	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
1. Infective and parasitic diseases	1.6	1.5	1.5	1.2	1.3	1.3	1.3	1.1	1.0	0.8	0.9	1.0
2. Neoplasms	18.8	18.9	18.5	18.5	18.3	18.4	18.5	18.6	18.6	19.3	18.9	18.8
3. Endocrine and metabolic diseases	2.9	2.6	2.8	2.6	2.7	2.0	2.0	1.6	1.7	1.8	2.2	2.1
4. Diseases of the blood	0.3	0.3	0.4	0.3	0.4	0.2	0.2	0.2	0.2	0.1	0.1	0.1
5. Mental disorders	0.5	0.7	0.9	1.4	1.3	1.4	1.7	1.2	1.3	1.5	1.6	1.5
6. Diseases of the nervous system	6.4	6.3	5.9	6.3	6.3	2.0	1.9	1.8	2.0	2.2	2.1	2.5
7. Diseases of the circulatory system	23.6	23.7	23.8	23.4	23.8	28.1	28.7	29.8	28.8	29.1	29.7	28.7
8. Diseases of the respiratory system	2.8	2.8	2.9	2.9	2.9	4.2	3.4	2.8	2.4	2.7	2.5	3.1
9. Diseases of the digestive system	4.3	4.3	4.9	4.6	4.7	5.0	4.7	5.0	5.6	5.6	5.6	6.0
10. Diseases of the genitourinary system	2.4	2.3	2.2	2.0	1.5	1.4	1.5	1.2	1.1	0.8	0.8	0.7
11. Complications of pregnancy and childbirth	-	-	-	-	-	-	-	-	-	-	-	-
12. Diseases of the skin and subcutaneous tissue	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13. Diseases of the musculoskeletal system and connective tissue	0.4	0.4	0.3	0.2	0.4	0.2	0.3	0.2	0.2	0.4	0.2	0.3
14. Congenital anomalies	2.0	2.5	2.4	2.1	2.4	2.7	2.4	2.1	2.4	2.2	2.4	1.9
15. Certain causes of perinatal morbidity and mortality	4.9	4.6	4.6	4.6	3.9	3.4	3.3	3.4	3.2	2.6	2.4	2.0
16. Symptoms and ill-defined conditions	0.5	0.7	0.6	0.8	0.6	0.7	0.5	0.8	0.7	0.9	0.7	1.0
17. Accidents, poisonings and violence	28.4	28.4	28.2	29.0	29.5	29.0	29.6	30.2	30.8	30.0	29.9	30.3
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %

Table 6.5. Distribution of man-years lost due to premature mortality by disease categories, 1964–1975. Men, percentages.

Disease category	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
1. Infective and parasitic diseases	1.4	1.5	1.5	1.2	1.4	1.5	1.4	1.4	1.1	1.0	1.1	1.3
2. Neoplasms	15.7	15.8	15.4	15.6	15.7	15.8	15.7	16.3	16.0	17.2	16.6	16.4
3. Endocrine and metabolic diseases	2.5	2.3	2.5	2.3	2.5	1.8	1.8	1.6	1.6	1.6	2.1	2.0
4. Diseases of the blood	0.3	0.3	0.4	0.3	0.4	0.2	0.3	0.2	0.2	0.2	0.2	0.2
5. Mental disorders	0.5	0.8	0.8	1.3	1.1	1.2	1.4	1.0	1.1	1.3	1.4	1.3
6. Diseases of the nervous system	5.6	5.4	5.2	5.6	5.4	2.4	2.1	2.1	2.2	2.4	2.4	2.9
7. Diseases of the circulatory system	17.6	17.7	17.9	17.8	18.2	21.8	22.3	23.1	22.6	22.9	23.6	23.1
8. Diseases of the respiratory system	3.1	2.9	3.2	3.1	2.9	4.3	3.6	2.7	2.5	2.6	2.6	3.0
9. Diseases of the digestive system	4.0	3.9	4.5	4.2	4.3	4.3	4.0	4.1	4.8	4.8	4.8	5.1
10. Diseases of the genitourinary system	2.0	2.0	1.9	1.6	1.4	1.3	1.3	1.1	0.9	0.7	0.7	0.7
11. Complications of pregnancy and childbirth	—	—	—	—	—	—	—	—	—	—	—	—
12. Diseases of the skin and subcutaneous tissue	0.1	0	0.1	0.1	0	0	0	0	0	0	0	0
13. Diseases of the musculoskeletal system and connective tissue	0.3	0.4	0.3	0.3	0.4	0.1	0.3	0.3	0.2	0.3	0.2	0.3
14. Congenital anomalies	4.9	5.4	5.0	4.4	5.3	5.7	5.3	4.7	5.4	5.0	5.3	4.3
15. Certain causes of perinatal morbidity and mortality	12.4	11.7	11.7	11.9	10.2	8.8	8.6	9.0	8.4	7.2	6.6	5.5
16. Symptoms and ill-defined conditions	0.5	0.7	0.6	0.8	0.5	0.8	0.6	0.9	0.9	1.2	0.9	1.3
17. Accidents, poisonings and violence	29.1	29.2	29.0	29.5	30.3	30.0	31.3	31.5	32.1	31.6	31.5	32.6
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %

Note: The table is based on data on mortality distributed by disease categories (Source: Statistiska centralbyrån, Dödsorsaker, various years) and age-distributed life expectancies (Source: Statistiska centralbyrån 1974).

Table 6.6. Distribution of lost production due to premature mortality by disease categories, 1964-1975. 1975 prices and 4 per cent discount rate. Women, percentages.

Disease category	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
1. Infective and parasitic diseases	1.7	1.7	1.3	1.5	1.2	1.5	1.5	1.3	1.2	1.3	1.5	1.3
2. Neoplasms	36.0	34.8	36.8	36.0	36.2	36.6	37.1	37.0	38.0	37.3	38.6	37.8
3. Endocrine and metabolic diseases	3.6	3.3	3.2	3.9	3.0	2.7	2.5	2.4	2.8	2.5	3.0	2.4
4. Diseases of the blood	0.4	0.4	0.3	0.6	0.4	0.3	0.3	0.3	0.3	0.3	0.1	0.2
5. Mental disorders	0.4	0.3	0.3	0.7	0.4	0.6	0.5	0.3	0.2	0.4	0.6	0.5
6. Diseases of the nervous system	8.7	8.6	8.2	8.4	8.9	1.8	1.9	2.5	2.2	3.0	2.5	2.8
7. Diseases of the circulatory system	14.5	15.5	14.7	14.3	14.5	20.1	18.9	20.6	19.4	19.5	18.6	19.8
8. Diseases of the respiratory system	2.8	2.8	2.9	2.9	3.0	4.8	3.4	3.1	2.5	3.0	2.8	2.6
9. Diseases of the digestive system	4.2	4.7	3.9	4.1	4.3	3.9	4.1	3.9	3.8	3.6	4.1	4.3
10. Diseases of the genitourinary system	3.2	3.3	3.0	2.8	2.6	2.3	2.1	1.8	1.7	1.4	1.5	1.3
11. Complications of pregnancy and childbirth	0.5	0.4	0.3	0.4	0.2	0.3	0.3	0.1	0.1	0.1	0.1	0.1
12. Diseases of the skin and subcutaneous tissue	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.1	0.0	0.0
13. Diseases of the musculoskeletal system and connective tissue	0.5	0.5	0.6	0.5	0.6	0.9	0.9	0.8	1.3	1.2	1.3	1.3
14. Congenital anomalies	3.3	3.3	3.4	3.1	3.5	3.2	3.1	4.0	3.9	4.1	3.2	3.5
15. Certain causes of perinatal morbidity and mortality	6.1	5.6	5.0	5.4	4.9	3.4	4.2	3.9	3.6	3.5	3.4	2.4
16. Symptoms and ill-defined conditions	0.5	0.6	0.4	0.5	0.3	0.6	0.4	0.3	0.5	0.5	0.6	0.6
17. Accidents, poisonings and violence	13.5	14.0	15.5	14.7	15.8	16.9	18.7	17.6	18.5	18.2	18.1	19.1
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %

Table 6.7. Distribution of man-years lost due to premature mortality by disease categories, 1964-1975. Women, percentages.

Disease category	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
1. Infective and parasitic diseases	1.7	1.8	1.5	1.7	1.2	1.7	1.7	1.4	1.3	1.4	1.7	1.7
2. Neoplasms	28.4	27.6	29.8	28.9	29.5	30.5	30.2	30.3	31.4	30.5	32.0	31.6
3. Endocrine and metabolic diseases	3.2	2.9	2.8	3.4	2.6	2.5	2.4	2.3	2.7	2.3	3.0	2.3
4. Diseases of the blood	0.4	0.4	0.3	0.7	0.4	0.4	0.4	0.3	0.3	0.4	0.2	0.2
5. Mental disorders	0.4	0.3	0.3	0.8	0.6	0.6	0.5	0.3	0.2	0.3	0.5	0.5
6. Diseases of the nervous system	7.3	7.3	7.0	7.2	7.4	2.0	2.1	2.8	2.5	3.4	2.9	3.1
7. Diseases of the circulatory system	10.9	11.7	11.2	10.9	11.2	15.8	14.7	16.2	15.2	15.4	14.8	16.0
8. Diseases of the respiratory system	3.0	3.2	3.2	3.5	3.4	5.0	3.6	3.4	2.4	2.8	2.9	2.6
9. Diseases of the digestive system	4.0	4.6	3.8	3.9	4.2	3.5	3.6	3.4	3.3	3.1	3.5	3.8
10. Diseases of the genitourinary system	2.5	2.8	2.5	2.3	2.3	1.9	1.8	1.4	1.4	1.2	1.3	1.2
11. Complications of pregnancy and childbirth	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.1	0.1	0.1	0.1	0.1
12. Diseases of the skin and subcutaneous tissue	0.1	0.1	0.2	0.2	0.1	0	0.1	0.1	0	0.1	0	0
13. Diseases of the musculoskeletal system and connective tissue	0.4	0.4	0.5	0.4	0.5	0.9	0.8	0.7	1.1	1.2	1.1	1.1
14. Congenital anomalies	7.1	7.1	7.2	6.3	7.4	7.0	6.6	8.3	8.2	8.8	7.2	7.4
15. Certain causes of perinatal morbidity and mortality	14.9	13.9	12.5	13.5	12.2	8.9	10.7	10.0	9.2	8.9	8.9	6.4
16. Symptoms and ill-defined conditions	0.6	0.6	0.4	0.5	0.3	0.6	0.5	0.5	0.9	0.9	1.1	1.1
17. Accidents, poisonings and violence	14.6	14.9	16.4	15.4	16.4	18.4	20.0	18.5	19.8	19.2	18.8	20.9
Total	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %

Note: See Table 6.5.

circulatory system and neoplasms decrease their respective shares. Certain causes of perinatal mortality increase their share markedly, to 12.4 per cent in 1964 and 5.5 per cent in 1975. The same state of affairs holds of course for congenital anomalies. This group increases its share to 4.9 per cent in 1964 and to 4.3 per cent in 1975.

Table 6.6 shows a corresponding distribution for women. The same three categories that are the most important causes of male deaths also dominate among the women. But the rank-orders are reversed. Here neoplasms are the most important cause of death, and this category's relative importance is on the rise. Diseases of the circulatory system come in second place, and this category largely has an unchanged share. Ranking third are injuries attributable to violence and poisoning; this category had the largest relative increase – over 40 per cent – between 1964 and 1975. The largest relative decreases are shown by diseases of the urogenital organs, complications of pregnancy and childbirth, and certain causes of perinatal mortality.

In the same way as for the men, we can compare the distribution of the production loss with the distribution of lost productive years for the women. The same categories dominate in Table 6.7, but injuries due to violence and poisoning have the second largest instead of the third largest share. So while injuries due to violence and poisoning are increasing their percentage as compared with Table 6.6, the shares are clearly falling for neoplasms as well as diseases of the circulatory system. Certain causes of perinatal mortality increases their share to 14.9 per cent in 1964 and 6.4 per cent in 1975. Congenital anomalies go up to 7.1 per cent in 1964 and to 7.4 per cent in 1975.

Notes

1. The reader is reminded of the fact that the WHO classification of diseases was somewhat changed in 1969; see Chapter 4.
2. It was stated in Chapter 5 that the wage often makes a good approximation of the value of production. However, as Uhde (1977), for instance, has pointed out, sex discrimination in the labour market may well result in wage-relations which do not correspond to differences in productivity. If this is the case, the estimating procedure used here will provide underestimates of the shares of those disease categories where women dominate.
3. For various reasons the data on diagnoses are not completely reliable. Alcohol abuse, for instance, was not a valid cause of early retirement before 1977. Other diagnoses were used instead, not necessarily belonging to the fifth main disease category, despite the fact that the "true" diagnosis actually was alcohol abuse. No adjustments of the official data have been made here, though.

7 Total costs of illness in Sweden 1975

According to Tables 2.1 and 5.1, respectively, health care consumption rose by 5 per cent a year and the indirect costs by 7.2 per cent. So, the indirect costs increased nearly 50 per cent faster than the direct costs and raised their share of the total costs of illness from about 65 per cent in 1964 to 70 per cent in 1975 (Table 7.1).

Even though it is possible to estimate roughly the development of direct and indirect costs at a highly aggregate level, the allocation by disease categories cannot be made for all the years studied. It clearly emerges from Chapters 4 and 6 that we have not been able to apportion all types of direct and indirect costs among the different disease categories. Data on outpatient care are available for only one year, and the data on short-term illness do not cover more than two years. As a result the complete picture of developments from 1964 to 1975 cannot be portrayed.

Table 7.1. Total costs of illness in Sweden 1964–1975. Direct costs of the health care system and loss of production due to short-term illness, permanent disability, and premature mortality, both sexes. 1975 prices and 4 per cent discount rate, percentages.

	1964	1965	1966	1967	1968	1969
Direct costs	35.6	33.4	32.9	34.5	34.8	32.7
Morbidity costs due to short-term illness	27.8	26.9	26.3	26.5	26.9	28.2
Morbidity costs due to permanent disability	10.8	12.6	18.4	16.7	16.5	18.9
Mortality costs	25.8	27.1	22.4	22.3	21.8	20.2
Total	100 %	100 %	100 %	100 %	100 %	100 %
	1970	1971	1972	1973	1974	1975
Direct costs	32.4	31.1	29.8	29.5	30.7	30.4
Morbidity costs due to short-term illness	27.9	26.5	24.8	25.3	26.9	27.7
Morbidity costs due to permanent disability	20.3	24.1	27.7	27.8	24.7	24.5
Mortality costs	19.4	18.3	17.7	17.4	17.7	17.4
Total	100 %	100 %	100 %	100 %	100 %	100 %

Sources: Tables 2.1 and 5.1.

In this chapter, however, an estimate of how the total costs break down by disease categories in 1975 will be presented. This estimate will then be compared with similar studies for USA 1975, Finland 1972 and Sweden 1945.

Sweden 1975

Estimating procedure. The estimate of the total costs of illness in Sweden 1975, distributed by main disease categories, was based on the following assumptions. In order to apportion the costs of inpatient care, indirect costs in consequence of permanent disability and mortality costs we have drawn upon the distributions shown in Tables 4.5, 6.2, 6.3, 6.4, and 6.6. The data from Tables 6.2, 6.3, 6.4, and 6.6 could be directly used in Table 7.2, where the discount rate is 4 per cent. Tables 7.3 and 7.4 moreover, set forth estimates of the production lost if 2.5 or 10 per cent is used as discount rate. The distribution of physician visits in 1975 was assumed to be the same as in Tierp in 1973 (Table 4.9) and short-term illness in 1975 was assumed to resemble the 1970 pattern (Table 6.1). As was pointed out earlier the value of housework was assumed to be just as great as the average earned income. Further, full employment and no changes in the productivity of the labour force were assumed. In Tables 7.2, 7.3, and 7.4 normal childbirths have been assigned to the eleventh category and dental care to diseases of the digestive system. In addition, an estimate was made for the costs of mental care (Table 4.4). It was not possible to make a breakdown for drugs, eyeglasses and other aids that are used outside the hospitals.

Results. Table 7.2 presents the results of the calculations of the direct and indirect costs, category by category, first in millions of kronor and second in per cent of the costs of all diseases. For future production losses use has been made here of a 4 per cent discount rate when the present value has been calculated. Out of the total economic costs of illness in 1975, the direct costs account for 30.4 per cent and of the indirect costs the mortality cost answers for 33.4 per cent. Seven categories each stand for markedly larger shares of the total costs than other categories, and we are going to look at these a little more closely.

Diseases of the circulatory system account for the largest share of the total costs by far (15.3 per cent). Not only that, but this category also bulks very large in each of the three different types of costs. For the rest there are big variations between the categories when it comes to dominant type of cost. The heavy proportion of total costs attributable to *diseases of the musculoskeletal system and connective tissue* are not so much due to high health-care costs but more to the substantial loss of production in consequence of illness and disability. Over a fourth of the morbidity costs can be charged to the thirteenth disease category. On the other hand, this category has an extremely small share of the mortality cost. *Mental disorders* have the largest share of the direct costs, a big share of the morbidity costs and a relatively small share of the mortality cost. *Neoplasms* and injuries due to *violence, poisonings and accidents* dominate the mortality costs (together with diseases of the

Table 7.2. Total economic costs of illness in Sweden, 1975. (Lost future earnings discounted at 4 per cent)

Disease category	Amount (In million SEK)			Percentage distribution				
	Total	Direct costs	Indirect costs		Total	Direct costs	Indirect costs	
			Morbidity	Mortality			Morbidity	Mortality
1. Infective and parasitic diseases	1,465	341	985	139	1,124	1.5	2.6	1.1
2. Neoplasms	5,438	1,189	1,132	3,117	4,249	5.3	3.0	24.3
3. Endocrine and metabolic diseases	1,638	557	805	276	1,081	2.2	2.1	2.2
4. Diseases of the blood	249	86	144	19	163	0.4	0.4	0.1
5. Mental disorders	10,774	3,503	7,113	158	7,271	15.7	18.6	1.2
6. Diseases of the nervous system	3,044	995	1,719	330	2,049	4.4	4.5	2.6
7. Diseases of the circulatory system	11,217	3,058	4,809	3,350	8,159	13.7	12.5	26.1
8. Diseases of the respiratory system	5,792	1,141	4,274	377	4,651	5.1	11.1	2.9
9. Diseases of the digestive system	5,783	3,051	2,023	709	2,732	13.7	5.3	5.5
10. Diseases of the genitourinary system	1,806	816	873	117	990	3.6	2.3	0.9
11. Complications of pregnancy and childbirth	769	585	182	2	184	2.6	0.5	0.0
12. Diseases of the skin and subcutaneous tissue	753	326	425	2	427	1.5	1.1	0.0
13. Diseases of the musculoskeletal system and connective tissue	11,140	1,196	9,871	73	9,944	5.3	25.7	0.6
14. Congenital anomalies	600	98	198	304	502	0.4	0.5	2.4
15. Certain causes of perinatal morbidity and mortality	344	69	-	275	275	0.3	-	2.1
16. Symptoms and ill-defined conditions	1,589	680	799	110	909	3.0	2.1	0.9
17. Accidents, poisonings, and violence	8,166	1,727	2,980	3,459	6,439	7.8	7.7	27.1
18. All other	584	584	-	-	-	2.6	-	-
19. Unallocated	2,384	2,384	-	-	-	10.6	-	-
Total	73,535	22,386	38,332	12,817	51,149	100 %	100 %	100 %

circulatory system). *Diseases of the digestive system* stand for nearly 14 per cent of the direct costs (this includes costs of dental treatment) but not even half as much of the indirect costs. *Diseases of the respiratory system* exhibit more or less the same pattern as diseases of the musculoskeletal system and connective tissue, where the morbidity costs dominate.

Discussion. These results are partly based on calculations which have discounted future production losses at a 4 per cent rate. The choice of discount rate is not self-evident, however, so for the sake of comparison we present the results of calculations using rates of 2.5 and 10 per cent. Table 7.3 sets out the total economic cost of illness in 1975 for the 2.5 per cent discount-rate case. The lower the discount rate chosen, the greater will be the indirect costs. So if 2.5 per cent is alleged to be a better choice than 4 per cent, we get two effects. First, the total economic costs of illness will go up; and second, the indirect costs will increase their share of the total costs. In this case the total costs increase by 5.9 per cent, and the indirect costs go up accordingly from 69.6 to 71.3 per cent.

However, lowering the discount rate from 4 to 2.5 per cent does not have any decisive effect on the relative distribution of costs among the different disease categories. The proportion goes up for those categories in which permanent disability or death often occurs at an early age. One example of that is injuries due to violence and poisoning, whose share is lifted from 11.1 per cent to 11.7 per cent of the total economic costs. On the other hand, the proportion falls off for categories of the kind where early retirement or death affects older age groups. A case in point is diseases of the circulatory system, whose share drops from 15.3 to 14.9 per cent. Another example is diseases of the musculoskeletal system and connective tissue, whose share falls from 15.1 to 14.8 per cent.

Table 7.4 sets out the total economic costs of illness in 1975 for the case using 10 per cent discount rate. Since a higher discount rate entails lower indirect costs, the choice of 10 instead of 4 per cent will not only lower the total cost but also reduce the share of those costs held by the indirect costs. A comparison of Table 7.2 with Table 7.4 shows that the total costs fall off by 13.8 per cent, while the share attributable to the indirect costs falls from 69.6 to 65.4 per cent.

An increase in the discount rate from 4 to 10 per cent makes some minor adjustments to the category-by-category share of the total economic costs. But they are important enough to rearrange part of the rank-order between those seven categories which have the decidedly largest share. Even though diseases of the musculoskeletal system and connective tissue drop a bit proportionately, this category now turns out to be the biggest instead of diseases of the circulatory system, which decline even more. Smaller shares can also be noted for neoplasms, for mental disorders and for injuries due to violence and poisoning. The shares have gone up for diseases of the respiratory system and of the digestive system. Diseases of the urogenital system have also increased in importance from 2.5 to 3.9 per cent of the total.

The influence exerted by age structure on indirect costs and their

Table 7.3. Total economic costs of illness in Sweden, 1975. (Lost future earnings discounted at 2.5 per cent)

Disease category	Amount (In million SEK)			Percentage distribution				
	Total	Direct costs	Indirect costs		Total	Direct costs	Indirect costs	
			Morbidity	Mortality			Morbidity	Mortality
1. Infective and parasitic diseases	1,552	341	1,035	176	1,211	1.5	2.6	1.2
2. Neoplasms	5,859	1,189	1,185	3,485	4,670	5.3	2.9	23.0
3. Endocrine and metabolic diseases	1,724	557	842	325	1,167	2.2	2.1	2.1
4. Diseases of the blood	468	86	152	230	382	0.6	0.4	1.5
5. Mental disorders	11,412	3,503	7,728	181	7,909	14.7	19.1	1.2
6. Diseases of the nervous system	3,232	995	1,835	402	2,237	4.1	4.6	2.6
7. Diseases of the circulatory system	11,606	3,058	4,908	3,640	8,548	13.7	12.2	24.0
8. Diseases of the respiratory system	6,077	1,141	4,498	438	4,936	7.8	11.2	2.9
9. Diseases of the digestive system	5,984	3,051	2,135	798	2,933	7.7	5.3	5.3
10. Diseases of the genitourinary system	1,870	816	923	131	1,054	2.4	2.3	0.9
11. Complications of pregnancy and childbirth	781	585	193	3	196	1.0	0.5	0.0
12. Diseases of the skin and subcutaneous tissue	775	326	447	2	449	1.0	1.1	0.0
13. Diseases of the musculoskeletal system and connective tissue	11,497	1,196	10,218	83	10,301	14.8	25.3	0.5
14. Congenital anomalies	776	98	217	461	678	1.0	0.5	3.0
15. Certain causes of perinatal morbidity and mortality	534	69	-	465	465	0.7	-	3.1
16. Symptoms and ill-defined conditions	1,668	680	843	145	988	2.1	2.1	1.0
17. Accidents, poisonings and violence	9,103	1,727	3,156	4,220	7,376	11.7	7.8	27.7
18. All other	584	584	-	-	-	0.7	-	-
19. Unallocated	2,384	2,384	-	-	-	3.1	10.6	-
Total	77,886	22,386	40,315	15,185	55,500	100 %	100 %	100 %

Table 7.4. Total economic costs of illness in Sweden, 1975. (Lost future earnings discounted at 10 per cent)

Disease category	Amount (In million SEK)				Percentage distribution			
	Indirect costs				Indirect costs			
	Total	Direct costs	Morbid-ity	Mortal-ity	Total	Direct costs	Morbid-ity	Mortal-ity
1. Infective and parasitic diseases	1,339	341	921	77	998	2.1	2.8	0.9
2. Neoplasms	4,346	1,189	958	2,199	3,157	6.7	2.9	24.4
3. Endocrine and metabolic diseases	1,366	557	637	172	809	2.1	1.9	1.9
4. Diseases of the blood	234	86	138	10	148	0.4	0.4	0.1
5. Mental disorders	8,843	3,503	5,238	102	5,340	13.8	15.7	1.1
6. Diseases of the nervous system	2,574	995	1,385	194	1,579	4.0	4.2	2.2
7. Diseases of the circulatory system	9,606	3,058	4,023	2,525	6,548	14.8	12.1	28.0
8. Diseases of the respiratory system	5,653	1,141	4,264	248	4,512	8.7	12.8	2.8
9. Diseases of the digestive system	5,550	3,051	2,012	487	2,499	8.6	6.1	5.4
10. Diseases of the genitourinary system	2,513	816	882	815	1,697	3.9	2.7	9.1
11. Complications of pregnancy and childbirth	779	585	193	1	194	1.2	0.6	0.0
12. Diseases of the skin and subcutaneous tissue	717	326	390	1	391	1.1	1.2	0.0
13. Diseases of the musculoskeletal system and connective tissue	9,675	1,196	8,428	51	8,479	15.0	25.3	0.6
14. Congenital anomalies	305	98	125	82	207	0.5	0.4	0.9
15. Certain causes of perinatal morbidity and mortality	116	69	-	47	47	0.2	-	0.5
16. Symptoms and ill-defined conditions	1,537	680	803	54	857	2.4	2.4	0.6
17. Accidents, poisonings and violence	6,501	1,727	2,837	1,937	4,774	10.1	8.5	21.5
18. All other	584	584	-	-	-	0.9	-	-
19. Unallocated	2,384	2,384	-	-	-	3.7	-	-
Total	64,622	22,386	33,234	9,002	42,236	100 %	100 %	100 %

relative distribution has been briefly discussed. Now we shall take a somewhat closer look at how the direct and indirect costs break down by age groups for a couple of categories. Diseases of the musculoskeletal system and connective tissue have been chosen together with injuries due to accidents, poisonings, and violence, but similar cost breakdowns by age can be done for all the 17 categories. Table 7.5 sets out our calculations for the case using a 4 per cent discount rate. It turns out that over 50 per cent of the total costs resulting from injuries due to violence and poisoning can be assigned to persons who are under 45. The same ages account for barely 20 per cent of the total costs attributable to diseases of the musculoskeletal system and connective tissue. Note, too, the clear-cut dominance for the younger age groups with regard to the indirect costs and for the older age groups with regard to the direct costs of health care. This pattern stands out with special clarity for injuries resulting from violence and poisoning. Also worth noting is the sizable proportion of morbidity costs for the 45–64 age group with regard to diseases of the musculoskeletal system and connective tissue: 75.8 per cent. (This age group in its entirety represents 23.9 per cent of the Swedish population.) In the category called "injuries due to accidents, poisonings and violence", the 15–44 age group accounts for 66.9 per cent of the mortality costs. (The whole of this age group constitutes 40.2 per cent of the Swedish population.)

Tables 7.6 and 7.7 set out corresponding calculations for those cases where the discount rate is 2.5 and 10 per cent, respectively. These tables, of course, are exactly the same as Table 7.5 as regards the direct health-care costs. On the other hand, the size of the indirect costs and their distribution in the age groups are affected. If a rate of 2.5 per cent is chosen the indirect costs go up, at the same time as the younger age groups take on rising shares of those costs, a fact that emerges from a comparison between Tables 7.5 and 7.6. If the rate chosen is 10 per cent the indirect costs fall off, at the same time as the older age groups take on growing shares of these costs, which will be seen when Table 7.5 is compared with Table 7.7.

In the following three sections the results of our estimates of the costs of illness in Sweden as of 1975 will be compared with the findings of similar studies available for other countries. Several studies have been done in the United States: for 1963 by Rice (1966), for 1972 by Cooper and Rice (1976) and for 1975 by Berk, Paringer and Mushkin (1978). For present purposes the last-named (and most recent) study is selected. For Finland 1972 there is Hemminki (1977) but at that point, sad to say, our international comparisons grind to a halt for lack of studies. Lastly, our results will be compared with a calculation made by Rydenfelt (1949) for Sweden in 1945.

Table 7.5. Costs of illness in Sweden 1975 due to diseases of the musculoskeletal system and connective tissue (WHO main disease category 13) and to accidents, poisonings, and violence (category 17). (Lost future earnings discounted at 4 per cent)

Diseases of the musculoskeletal system and connective tissue									
Age group	Amount (In million SEK)			Percentage distribution					
	Total	Direct costs	Morbidity	Indirect costs			Total	Mortality	Share of total population
				Morbidity	Total	Direct costs			
0 - 14	22	20	-	2	2	1.7	-	2.7	20.7
15 - 44	2,178	172	1,988	18	2,006	14.4	20.2	24.7	40.2
45 - 64	7,945	409	7,485	51	7,536	34.2	75.8	69.9	23.9
65 - 74	713	313	398	2	400	26.2	4.0	2.7	9.5
75 - w	282	282	-	-	2.5	23.5	-	-	5.7
All ages	11,140	1,196	9,871	73	9,944	100 %	100 %	100 %	100 %
Accidents, poisonings, and violence									
0 - 14	270	90	-	180	180	5.2	-	5.2	20.7
15 - 44	3,956	297	1,345	2,314	3,659	17.2	45.2	66.9	40.2
45 - 64	2,763	299	1,509	955	2,464	17.3	50.6	27.6	23.9
65 - 74	424	288	126	10	136	16.7	4.2	0.3	9.5
75 - w	753	753	-	-	9.2	43.6	-	-	5.7
All ages	8,166	1,727	2,980	3,459	6,439	100 %	100 %	100 %	100 %

Table 7.6. Costs of illness in Sweden 1975 due to diseases of the musculoskeletal system and connective tissue (category 13) and to accidents, poisonings, and violence (category 17). (Lost future earnings discounted at 2.5 per cent)

Diseases of the musculoskeletal system and connective tissue										
Age group	Amount (In million SEK)				Percentage distribution					
	Total	Direct	Indirect costs		Total	Direct	Indirect costs			Share of total population
			Morbidity costs	Mortality			Morbidity costs	Mortality	Total	
0 - 14	24	20	-	4	0.2	1.7	-	4.8	0.0	20.7
15 - 44	2,287	172	2,093	22	2,115	14.4	20.5	26.5	20.5	40.2
45 - 64	8,194	409	7,730	55	7,785	34.2	75.6	66.3	75.7	23.9
65 - 74	710	313	395	2	397	26.2	3.9	2.4	3.8	9.5
75 - w	282	282	-	-	2.3	23.5	-	-	-	5.7
All ages	11,497	1,196	10,218	83	10,301	100 %	100 %	100 %	100 %	100 %

Accidents, poisonings, and violence										
Age group	Amount (In million SEK)				Percentage distribution					
	Total	Direct	Indirect costs		Total	Direct	Indirect costs			Share of total population
			Morbidity costs	Mortality			Morbidity costs	Mortality	Total	
0 - 14	371	90	-	281	4.1	5.2	-	6.7	3.8	20.7
15 - 44	4,620	297	1,438	2,885	50.7	17.2	45.6	68.3	58.6	40.2
45 - 64	2,930	299	1,588	1,043	32.2	17.3	50.3	24.7	35.7	23.9
65 - 74	429	288	130	11	4.7	16.7	4.1	0.3	1.9	9.5
75 - w	753	753	-	-	8.3	43.6	-	-	-	5.7
All ages	9,103	1,727	3,156	4,220	7,376	100 %	100 %	100 %	100 %	100 %

Table 7.7. Costs of illness in Sweden 1975 due to diseases of the musculoskeletal system and connective tissue (category 13) and to accidents, poisonings, and violence (category 17). (Lost future earnings discounted at 10 per cent)

Diseases of the musculoskeletal system and connective tissue										
Age group	Amount (In million SEK)			Percentage distribution						
				Indirect costs						
	Total	Direct costs	Morbidity	Mortality	Total	Direct costs	Morbidity	Mortality	Total	Share of total population
0 - 14	21	20	—	1	0.2	1.7	—	1.9	0.0	20.7
15 - 44	1,874	172	1,692	10	1,702	14.4	20.1	19.2	20.1	40.2
45 - 64	6,789	409	6,342	39	6,380	34.2	75.2	75.1	75.3	23.9
65 - 74	709	313	394	2	396	26.2	4.7	3.8	4.6	9.5
75 - w	282	282	—	—	—	23.5	—	—	—	5.7
All ages	9,675	1,196	8,428	51	8,478	100 %	100 %	100 %	100 %	100 %

Accidents, poisonings, and violence										
Age group	Amount (In million SEK)			Percentage distribution						
				Indirect costs						
	Total	Direct costs	Morbidity	Mortality	Total	Direct costs	Morbidity	Mortality	Total	Share of total population
0 - 14	133	90	—	43	43	5.2	—	2.2	0.9	20.7
15 - 44	2,751	297	1,267	1,187	2,454	17.2	44.7	61.3	51.4	40.2
45 - 64	2,435	299	1,439	697	2,136	17.3	50.7	36.0	44.7	23.9
65 - 74	429	288	131	10	141	16.7	4.6	0.5	3.0	9.5
75 - w	753	753	—	—	—	43.6	—	—	—	5.7
All ages	6,501	1,727	2,837	1,937	4,774	100 %	100 %	100 %	100 %	100 %

United States 1975

In Berk, Paringer and Mushkin (1978) estimates of the economic costs of illness in the US are broken down by disease categories; the studied year is 1975. The authors used three rates of discount to calculate the mortality costs: 2.5, 4 and 10 per cent. For the case using 4 per cent, no productivity increase is postulated, while the use of 2.5 and 10 per cent postulates such an increase of 2 per cent per annum. Table 7.8 reproduces the estimate which uses the 4 per cent discount rate.

Estimating procedure. By and large Berk, Paringer and Mushkin used the same method of calculation that we do, though there may be differences of detail. Berk, Paringer and Mushkin included the costs of new capital investment and medical research, whereas the present calculations are confined to the costs of health-care consumption, including capital depreciation. Further, Berk, Paringer and Mushkin made a more refined calculation of the production value of housework. Moreover, they worked with unemployment probabilities differentiated by age and sex, as well as with the assumption that remaining life expectancy will change in future in a specified manner. Here it is posited instead (1) that there is always full employment; and (2) that remaining life expectancy in different age groups and for both sexes will be the same as in 1971 for all time to come, or in any event for the next 65 years.

Results and comparison with Sweden. As of 1975 the direct costs of health care in the US came to 118,500 million dollars (497,700 million Swedish kronor). That comes to \$555 (about SEK 2,330) per capita and represents 7.8 per cent of the US gross domestic product. But included in these costs are investments outlays, *i.e.* capital expenditures. If we add such costs to our figures for health-care consumption in Sweden, the corresponding number for Sweden work out at SEK 2,979 per capita and 8.5 per cent of GDP. According to Berk, Paringer and Mushkin, the direct costs amount to 44.8 per cent of the total economic costs, whereas our calculations for Sweden suggest a figure of 28.7 per cent. Part of that difference is explained by the aforementioned inclusion of capital investment with the direct costs. If we had followed suit the proportion would have risen to 32.3 per cent.

Another part of the differences in the direct – indirect cost breakdown is explained by differences in assumptions used in the calculations. Expected future losses of production due to permanent disability resulting from present morbidity (prevalence) were excluded from the American study but included in our calculations. For that reason our estimates of the morbidity costs should be a little higher than the estimates made by Berk, Paringer, and Mushkin.

A third possible explanation may be differences between Sweden and the USA in the conditions required for early retirement and in the potential benefits of early retirement. It might be the case, for instance, that a certain reduction in health and work capacity would lead to early retirement more often in Sweden than in the USA, where, on the other hand, the corresponding individual may switch to an easier and less well-paid job. Our calculations probably overestimate the loss of production in this case, while the American calculations underes-

Table 7.8. Total economic costs of illness in USA 1975. (Lost future earnings discounted at 4 per cent)

Disease category	Amount (In million U.S. \$)			Percentage distribution				
	Total			Indirect costs		Direct costs		
	Total	Direct costs	Morbid-ity	Mortal-ity	Total	Total	Direct costs	Total
1. Infective and parasitic diseases	4,648	2,027	1,559	1,062	2,621	1.8	1.7	1.2
2. Neoplasms	22,358	5,279	1,105	15,974	17,079	8.5	4.5	11.7
3. Endocrine and metabolic diseases	6,731	3,337	1,695	1,699	3,394	2.5	2.8	2.3
4. Diseases of the blood	1,255	676	281	298	579	0.5	0.5	0.4
5. Mental disorders	19,187	9,411	8,751	1,025	9,776	7.3	7.9	6.7
6. Diseases of the nervous system	14,566	7,459	5,706	1,401	7,107	5.5	6.3	4.9
7. Diseases of the circulatory system	50,408	16,017	8,744	25,647	34,391	19.1	13.5	23.6
8. Diseases of the respiratory system	19,752	7,571	8,542	3,639	12,181	7.5	6.4	8.4
9. Diseases of the digestive system	22,803	14,564	3,438	4,801	8,239	8.6	12.3	5.7
10. Diseases of the genitourinary system	8,205	5,575	1,770	860	2,630	3.1	4.7	1.8
11. Complications of pregnancy and childbirth	3,660	3,387	193	80	273	1.4	2.9	0.2
12. Diseases of the skin and subcutaneous tissue	2,594	2,120	399	75	474	1.0	1.8	0.3
13. Diseases of the musculoskeletal system and connective tissue	12,717	5,113	7,351	253	7,604	4.8	4.3	5.2
14. Congenital anomalies	2,500	432	437	1,631	2,068	0.9	0.4	1.4
15. Certain causes of perinatal morbidity and mortality	3,387	64	—	3,323	3,323	1.3	0.2	2.3
16. Symptoms and ill-defined conditions	6,916	3,180	1,260	2,476	3,736	2.6	2.7	2.6
17. Accidents, poisonings and violence	36,196	6,846	5,669	23,681	29,350	13.7	5.8	20.1
18. All other	7,262	6,316	946	—	946	2.7	5.3	0.6
19. Unallocated	19,126	19,126	—	—	—	7.2	16.1	—
Total	264,272	118,500	57,846	87,926	145,772	100 %	100 %	100 %

Source: Berk, Paringer, and Mushkin (1978).

timate the loss of production, since they do not include the effects of reduced income resulting from illness.¹

But there are similarities, too. A comparison of Table 7.2 with Table 7.8 shows a remarkable resemblance between Sweden and the United States in the percentage distribution of their direct health-care costs ($\chi^2 = 5.60$; 17 degrees of freedom). Indeed, the only really disparate difference is to be found for mental disorders: 15.7 per cent in Sweden and 7.9 per cent in the US. On the whole the resemblances persist even when the percentage distributions of the total costs are compared. But now the differences between Sweden and the United States are greater ($\chi^2 = 11.6$; 17 degrees of freedom). The most striking difference is for diseases of the musculoskeletal system and connective tissue: 14.8 per cent in Sweden and only 4.8 per cent in the USA. Note, too, that not all direct costs could be apportioned, neither in the Swedish nor in the American study. In the Swedish study this finding holds for drugs and various therapeutic aids, in the American for new capital investment and medical research.

Where the indirect costs are concerned, the mortality costs stand for a smaller proportion in Sweden than in the United States: only 25.1 per cent in the former as against 60.3 per cent in the latter. Two possible explanations of the higher estimates of morbidity costs in Sweden were mentioned above. The same categories (mental disorders, diseases of the circulatory system, diseases of the respiratory system and diseases of the musculoskeletal system and connective tissue) have the four largest shares of the morbidity costs. In Sweden, diseases of the musculoskeletal system and connective tissue clearly dominate with 25 per cent. In the US, the four largest categories have more or less the same-sized proportions, ranging from 12.7 per cent to 15.1 per cent. Under the head of mortality costs, the three largest shares by far are attributable to neoplasms, diseases of the circulatory system and injuries due to violence and poisoning. Moreover, the proportions are pretty much alike in the two countries.

Summing up, we can say that the US and Sweden differ considerably when it comes to the direct-indirect cost breakdown of the total costs and to the mortality-morbidity cost breakdown of the indirect costs, the differences probably being largely due to differences in assumptions and methodology. By contrast, there are rather big similarities as regards the breakdown of total costs by disease categories, and the similarities are remarkably great with regard to distribution of the direct health-care costs.

Finland 1972

Hemminki (1977) presents the results of a study which breaks down the direct and indirect costs of illness in Finland in 1972 by disease categories. The results are summarized in Table 7.9.

Estimating procedure. The following points should be noted. Of the direct health-care costs, it was only the hospital costs that could be distributed among categories. According to Hemminki (1972) such costs

Table 7.9. Total economic costs of illness in Finland, 1972. (Lost future earnings not discounted)

Disease category	Amount (In million FMK)			Percentage distribution					
	Total	Direct costs	Indirect costs		Total	Direct costs	Indirect costs		Total
			Morbidity	Mortality			Morbidity	Mortality	
1. Infective and parasitic diseases	418	112	256	50	306	7.6	2.9	1.3	2.4
2. Neoplasms	748	102	128	518	646	6.9	1.4	14.0	5.1
3. Endocrine and metabolic diseases	240	35	164	41	205	2.4	1.8	1.1	1.6
4. Diseases of the blood	23	11	6	6	12	0.7	0.1	0.2	0.1
5. Mental disorders	2,510	343	2,145	22	2,167	23.3	24.0	0.6	17.1
6. Diseases of the nervous system	592	60	455	77	532	4.1	5.1	2.1	4.2
7. Diseases of the circulatory system	3,419	251	2,228	940	3,168	17.1	24.9	25.3	25.0
8. Diseases of the respiratory system	659	78	467	114	581	5.3	5.2	3.1	4.6
9. Diseases of the digestive system	308	93	126	89	215	6.3	1.4	2.4	1.7
10. Diseases of the genitourinary system	158	60	68	30	98	4.1	0.7	0.8	0.8
11. Complications of pregnancy and childbirth	106	87	17	2	19	5.9	0.2	0.1	0.2
12. Diseases of the skin and subcutaneous tissue	61	15	43	3	46	1.0	0.5	0.1	0.4
13. Diseases of the musculoskeletal system and connective tissue	2,312	70	2,230	12	2,242	4.8	24.9	0.3	17.7
14. Congenital anomalies	293	14	124	155	279	1.0	1.4	4.2	2.2
15. Certain causes of perinatal morbidity and mortality	260	7	-	253	253	0.5	-	6.8	2.0
16. Symptoms and ill-defined conditions	74	36	25	13	38	2.5	0.3	0.3	0.3
17. Accidents, poisonings and violence	1,894	95	417	1,382	1,799	6.5	4.7	37.3	14.2
18. All other	50	-	50	-	50	-	0.5	-	0.4
Total	14,125	1,469	8,949	3,707	12,656	100 %	100 %	100 %	100 %

Source: Hemminki (1977).

Note: Here the direct costs include only hospital care. Hospital costs do not account for more than 44 per cent of the direct health care costs. Among the indirect costs short-term illness resulting in less than eight days of absence from work is excluded. This is estimated to account for ten per cent of the indirect costs.

make up no more than 44 per cent of all the 1972 expenditures for health care in Finland. Distribution of the total hospital costs among the various disease categories has assumed any one bed day to be just as expensive as the rest, regardless of which disease has been treated or where the treatment was administered. With regard to the indirect costs, there is no way of categorizing short-term illness which lasts for 7 days at the most. Such illness is estimated to account for 10 per cent of the indirect costs. For short-term illness lasting longer than 7 days, for early retirement and for premature death (here before the age of 65), the number of lost production years have been calculated first. These have then been multiplied by the average income of men and of women. No discounting is made on the grounds that the choice of rate would be arbitrary. But this reason is not particularly convincing, since the choice of a zero discount rate is also arbitrary.

Another thing to observe is that Hemminki (1977) adds disbursed sickness benefits and early retirement pensions to the costs reported here. Such a procedure must be avoided. Disbursed compensations of this kind are transfer payments, which are not matched by any real use or consumption of society's resources. Hence they do not affect the overall production result in society but in principle only its distribution. To add in this context certain transfer payments to the production loss can be said to imply a double-counting, since the whole indirect cost is already included in the production loss.² So transfer payments are not included in Table 7.9.

Results and comparisons with Sweden. In 1972 the direct costs of health care in Finland amounted to 3,400 million Finnish marks (3,910 million Swedish kronor). That comes to FMK 728 (about SEK 837) per capita and makes up 6.1 per cent of the Finnish gross domestic product. The respective figures for Sweden are SEK 1,734 per capita and 7.1 per cent of GDP. According to Hemminki's estimates, the direct costs account for 19.4 per cent of the total economic costs. Since Hemminki uses a discount rate of zero per cent, his calculations are most comparable to our results employing a 2.5 per cent discount rate (Table 7.3). Hemminki's choice of rate leads *per se* to higher indirect costs. As expected, our calculation gives a larger share for the direct health-care costs (28.7 per cent).

Because Hemminki was only able to apportion the costs of inpatient care, it is not altogether easy to compare Finland and Sweden for the percentage distribution of their direct health-care costs, category by category, but a few comments shall be made anyway. In Finland mental disorders, diseases of the circulatory system, infective diseases and neoplasms are the four biggest categories in the perspective of hospital economics. Injuries due to violence and poisonings also have a large share. With the exception of infective diseases, this is more or less the same pattern as for the hospitals in Sweden (Table 4.5). The Finland of 1973 resembled the Sweden of 1964 in the relative extent of its infective diseases. But since 1964 this proportion has declined considerably in Sweden, as will be seen from Table 4.5. If the costs of outpatient care had had the same distribution as for inpatient care, we could have gone a step farther and also compared the breakdowns

of the total direct costs. In view of the dissimilarities to be found in Sweden (Tables 4.5 and 4.9) it is not likely that the distribution of outpatient care is even approximately the same as that of inpatient care in Finland. For instance, inclusion of dental care among the costs of diseases of the digestive system means that this category will increase its share.

Turning now to the indirect costs we can first observe, when comparing Tables 7.3 and 7.9, that the mortality costs account for reasonably equal shares in the two countries: 29.3 per cent in Finland and 37.7 per cent in Sweden. But if we had used the same discount rate as Hemminki (zero per cent), the mortality costs would have bulked even larger in Sweden. Because of Hemminki's failure to apportion short-term illness which does not last for more than 7 days, the shares for certain disease categories, *e.g.* infective diseases, is presumably underestimated among the morbidity costs. Still in all, we can see that the same categories (mental disorders, diseases of the circulatory system and diseases of the musculoskeletal system and connective tissue) account for the three largest shares. In Finland the three are of about the same size, 24–25 per cent, whereas diseases of the musculoskeletal system and connective tissue are the only category which comes anywhere near that size in Sweden. Among the mortality costs it is once again the same categories which have the three largest shares: neoplasms, diseases of the circulatory system and injuries due to violence and poisoning. In Sweden these three categories are of roughly equal size (23–29 per cent), while in Finland there is considerable variation, with injuries caused by violence and poisoning as the clearly dominant category (37.3 per cent). However, the differences in the category-by-category breakdown of the indirect costs are not so great as to rule out the null hypothesis, *i.e.* that the percentage distributions are the same ($\chi^2 = 9.67$; 16 degrees of freedom).

Summing up, we can say that distribution of the total costs between direct and indirect types, and of the indirect costs between mortality costs and morbidity costs, shows approximately the same pattern in Finland as in Sweden. In as much as Hemminki could apportion only 44 per cent (*viz.* the costs of inpatient care) of the direct costs, no direct comparison can be made for these. In the main, the breakdown of the indirect costs in both countries shows significant likenesses.

Sweden 1945

In "Sjukdomarnas samhällsekonomska aspekt" (The Economic Aspect of Diseases), a thesis that Sven Rydenfelt wrote for the Swedish licentiate degree in 1949, estimates of partly the same type as the ones given here are presented for the first time in Sweden. As far as I can see, Rydenfelt's study is among the first of its kind in the world.⁴

Estimating procedure. Rydenfelt (1949) adopts a slightly different starting point. His objectives are to investigate (1) how much of public expenditures are determined by diseases; (2) how much of private expenditures are determined by diseases; and (3) how big the total production decline is in our society in consequence of diseases. The private

and public expenditures are made to include not only the costs of the health and medical services, but also transfer payments such as old-age pensions disbursed to persons who have not reached the age of 67, government subsidies to health insurance, and private maintenance. The public expenditures in Rydenfelt's study include capital investment. On the other hand, the expenditures for childbirth and accidents have been excluded, since these outlays are not directly caused by any disease. However, no attempt is made to apportion the private and public expenditures among different diseases or disease categories. Rydenfelt's calculation suggests that sickness and ill health caused the inhabitants of Sweden private and public outlays totalling 902 million kronor in 1945. This comes to around SEK 135 per capita in current prices, or SEK 514 in 1975 prices. The health and medical services alone, including childbirths and accidents, stood for around 624 million kronor, *i.e.* SEK 93 per capita in current prices or SEK 354 per capita in 1975 prices. Health-care consumption constituted 3.3 per cent of the gross domestic product in 1949.

But according to Rydenfelt, "the amounts and relations we arrive at here are very much dependent on the particular country's economic and social development. Actually, they tell us more about the rate of development than about the prevalence and importance of the diseases. . . . If we want to form a more objective picture of the economic and social role of illness in a society . . . we must . . . investigate its effect on the citizenry's working capacity, in other words find out how many working years are lost due to illness (p. 10)." In short, Rydenfelt sees the indirect costs as being the most important in the economic perspective. After some discussion, however, he abstains from figuring out the mortality costs. "But for the existence of diseases, the population of our country would probably have been much greater than it is now. Seen from the viewpoint of the national economy, would such a high population figure have entailed a gain or a loss for our country (p. 72)?" In Rydenfelt's opinion, this is a question that admits of no answer, this because one must then be able to figure out "the demographic optimum, *i.e.* the population at which the most favourable conditions lie for a high standard of living" (p. 72), a task that poses not a few perplexities.

So among the indirect costs, Rydenfelt restricts himself to the morbidity costs. Here he proceeds from the health insurance statistics. In 1945, however, persons belonging to the recognized sickness benefit societies numbered only 47 per cent of the adult population. Nor were there any published statistics on the age distribution of those who benefited from health insurance. Rydenfelt was therefore compelled to make several assumptions that it was not necessary to introduce in our estimate. On the basis of the health insurance statistics available to him, Rydenfelt arrives at a figure of 130,000 lost production years. In addition, he figures out how many production years were lost on account of early retirement. Since he assumes that the 138,000 early retirees retain one-fourth of their normal working capacity, the estimated number of lost production years will be 104,000. However, Rydenfelt's estimate does not stop there. He makes a final, cautious guess of how

many production years will be lost because even though people return to work, their capacity will be impaired by illness. Rydenfelt comes up with a figure of 60,000 lost production years, which is equivalent to an impairment of working capacity by an average 1–2 per cent.

Results. According to Rydenfelt's calculations, the total production loss works out at about 300,000 production years for 1945. But this figure does not include working years lost due to accidents, which Rydenfelt has estimated at 100,000. To permit comparison with the calculations made here, we therefore add this number but subtract the 60,000 years which are expected to go lost due to temporary minor impairment of working capacity. In that case nearly 340,000 production years would have been lost in 1945 in consequence of diseases and accidents. Our estimates give about 375,000 lost production years in 1964 and 600,000 in 1975.

Rydenfelt translates the 300,000 production years into a production loss expressed in kronor as follows. The whole gross national income for 1945, amounting to SEK 18,400 million, is divided by those 4.3 million people who are healthy and able-bodied. But since the latter figure, though not the former, includes persons who work in the home, the calculation underestimates the average earned income. On the other hand, inclusion is made of "unearned" income or investment income, which is not affected whether a person is working or not. In any event, Rydenfelt thereby arrives at an average value of about 4,300 kronor. This figure is revised downwards to 4,000 kronor to allow for "the law of diminishing returns". The monetary loss then comes to SEK 1,200 million. Hence the diseases caused national income to drop by 6 per cent in 1945.

Lastly, Rydenfelt figures out how many production years are lost in consequence of the most usual diseases or disease categories. The results of the calculations are presented in Table 7.10. For the sake of comparison the 100,000 production years that have been lost on account of accidents are included here. It is of course difficult to compare directly the percentages above with those we have found, notably because we have been able to work with data material that rests on statistically surer ground. If comparison is made with Table 7.3, it will at all events be seen that injuries due to violence and poisoning, diseases of the musculoskeletal system and connective tissue, mental disorders and diseases of the circulatory system have great importance both in 1945 and 1975. A remarkable datum is the large proportion (25 per cent) for accidents in 1945. In 1975 injuries resulting from violence and poisoning accounted for 8 per cent of the morbidity costs by our calculation.

Table 7.10. The indirect costs of illness (*viz.* the morbidity costs) in Sweden, 1945, distributed by diseases or disease categories. Number of lost man-years and percentages.

Disease	Lost man-years	Per cent
Accidents	100,000	25.0
Rheumatic diseases	50,000	12.5
Mental disorders	50,000	12.5
Heart diseases	35,000	8.8
Tuberculosis	25,000	6.3
Neoplasms	5,000	1.2
Diabetes	5,000	1.2
Acute diseases of the upper respiratory tract	30,000	7.5
Unallocated	100,000	25.0
Total	400,000	100 %

Source: Rydenfelt (1949).

Notes

1. This source of underestimation has been analysed by Bartel and Taubman (1979); see Chapter 5, note 4.
2. Warnings against double counts of this type also abound in the health economics literature, see *e.g.* Klarman (1965).
3. On the other hand, people in Finland may have time preferences that are different from those of the Swedes. Therefore it is not obvious that the comparisons between countries should be based on the same discount rate.
4. Strictly speaking, the only similar early studies are those by Dublin and Whitney (1920) and by Dublin and Lotka (1946). However, Rydenfelt was not aware of their existence when he wrote his dissertation.

8 Summary and closing comments

In this book the development of direct health-care costs and of the indirect costs attributable to lost production due to illness, disability, and premature death between 1964 and 1975 has been described and analysed, following the prevalence approach. All told, the consumption of health care rose by 5 per cent per annum and the indirect cost by 7.2 per cent (provided a rate of 4 per cent was chosen to discount future production losses). The indirect costs thus increased nearly 50 per cent faster than the direct costs. However, the sharp increase in costs cannot be interpreted straight off to mean that the Swedish people are getting sicker and sicker with every passing year. The costs of illness depend not only on the incidence or prevalence of studied diseases, but also on (say) how the health insurance scheme is designed, how the system of health care is organized in the main, and how health care operates in the specific case.

Available figures for the period 1964–1975 make it possible to apportion the mortality costs, the indirect costs resulting from permanent disability and the hospital costs among disease categories, even though there are lacunae in the statistical material for single years. Diseases of the circulatory system comprise one of the clearly dominant disease categories in relation to all these three types of costs. The costs of such diseases rose at roughly the same rate as the average rate of increase for all categories, 5–7 per cent, for which reason their share of the total costs remained unchanged. Injuries due to violence and poisoning play an increasingly important role for the movement of mortality costs and hospital costs. That finding also holds for neoplasms. None of these categories is a leading cause of early retirement, however. When it comes to permanent disability the most important disease category is that made up of diseases of the musculoskeletal system and connective tissue. This category increased its proportion of the total production loss due to permanent disability from 16.0 per cent in 1966 to 28.4 per cent in 1975 for men, and from 16.0 per cent to 33.9 per cent for women. (Both cases posited a discount rate of 4 per cent.)

Some figures are also available with regard to short-term illness and outpatient care, which enables us (by drawing upon certain assumptions) to calculate the distribution of costs by disease for at least one year. For this purpose the closing year of the present study, 1975, was selected. The results were compared with Finland 1972 (Hemminki 1977) and the United States 1975 (Berk, Paringer, and Mushkin 1978). The comparisons revealed some important similarities. For example, Finland and Sweden appeared to exhibit more or less the same pattern in the distribution of their total costs as between direct and indirect costs and

in the distribution of their indirect costs as between mortality costs and morbidity costs. The resemblances among the three countries still preponderate when it comes to the percentage distribution of the direct or indirect costs by disease categories. In all three countries the diseases of the circulatory system dominate. Accidents, violence, and poisonings are another very important category in the three countries.

There are also differences between the three countries, according to the three studies. There are, for instance, rather big dissimilarities between the United States and Sweden with regard to the direct-indirect breakdown of total costs and the mortality-morbidity breakdown of the indirect costs. There are certain differences also when it comes to the percentage distribution of the economic costs by disease categories. Diseases of the musculoskeletal system and connective tissue, for example, have substantially larger shares of the economic costs of illness in Sweden and Finland than in the United States.

Such dissimilarities as these may serve as the starting point of further analysis. For instance, why is the share of the direct costs of mental disorders smaller in Sweden than in Finland and much smaller in the United States? Is it because of differences in the incidence or prevalence of mental disorders? If not, what differences in the treatment of mental disorder in the three countries may explain the discrepancies in the direct costs? Why is the share of morbidity costs of diseases of the musculoskeletal system and connective tissue in the United States only half of the corresponding ones in Finland and Sweden? Is it because of differences in the incidence or prevalence of these diseases? To what extent can the divergencies be explained by differences in compensation schemes and labour market conditions? And so on, and so forth.

In some cases, however, the divergences between the three countries may be due more to differences in the method of measurement or in the way, by which various problems of measurement are dealt with, than to actual differences. The differences between the United States and Sweden when it comes to the direct-indirect cost breakdown of the total economic costs of illness and to the morbidity-mortality costs breakdown of the indirect costs may be one example of the effects of differences in methods of measurements and estimation.

Even though all three studies used the prevalence approach in estimating the costs of illness, there is still room for many different interpretations of this approach with regard to various problems of measurement and estimation. Unemployment is such a problem, and different assumptions on its size and its significance when calculating the indirect costs of illness may distort comparisons. For instance, the present study assumed no unemployment at all, while 1–2 per cent might have been a more realistic assumption, and the American study used a 4–5 per cent unemployment rate in order not to include the costs of unemployment in the estimate of the loss of output due to illness. There are other differences, too, between the studies in dealing with the problems of measurement and estimation. One difference concerns how the necessary imputation of a value to unpaid household work has been made. Another one is the choice of discount rates. There are also differences between the countries as to availability of data, which

explains the different methods used in estimating the costs of permanent disability.

The comparisons between Finland, Sweden, and the United States made in Chapter 7 would have been more reliable, had the estimates been based (or had it been possible to base the estimates) on the same definitions and assumptions and on the same kind of data. International comparisons of the costs of illness are important, and in order to facilitate such comparative studies in the future, the cost-of-illness accounting should use consistently the same methodology and the same kind of data. This calls for international guide-lines for cost-of-illness accounting. Naturally, a commonly used methodology would benefit not only international comparative studies between countries but also intertemporal comparisons within countries.

In this study it was not possible to break down the drug costs by disease categories owing to lack of data. But with the advent of the continuously updated file, Medical Index Sweden, as from 1978–79, it will be more feasible to make such breakdowns in coming cost-of-illness studies. Moreover, Medical Index Sweden will presumably be able to furnish us with reliable data on how visits to physicians break down by disease categories, about which we now receive sporadic information at best. In that case all that remains are the short-term illnesses. However, the Swedish Social Insurance Board will, hopefully, publish data of this kind from time to time in the future. The result would be to make available all the basic prevalence data needed to describe and analyse the movement of the costs of illness, following the prevalence approach. Naturally, these data are not primarily collected in order to make cost-of-illness studies, a fact which may distort the results. Nevertheless, we shall presumably have to rely mainly on secondary data in future cost-of-illness studies, too.

Estimates of the costs of illness, following the prevalence approach, indicate the costs due to the *existence* of disease in a specific year. This approach is the most suitable approach when evaluating various attempts to reduce the costs of illness in the prevalence population. By contrast, the measure of the costs of illness based on the incidence approach includes all present and future costs of health care resources used due to the *onset* of the disease in a specific year. It also includes expected present and future losses of output. The incidence approach provides the best measures of the costs that may be averted by programmes aimed at preventing a new case of the disease or injury. It would have been interesting to make comparisons between estimates based on both approaches. The cost of incidence is, however, extremely difficult to estimate. It requires good projections of the likely pattern of disease and treatment from onset to death. The lack of suitable data however, made incidence-based estimates impossible to make in the present study.

Both incidence-based and prevalence-based estimates are useful in the analysis of long-term effects of introducing new preventive measures. Suppose, for example, someone discovered a vaccine that was active against cancer. The immediate consequences of introducing such a vaccine would be fewer early retirements and fewer persons who

died before reaching retirement age. The costs of inpatient care would decrease and the costs of vaccination in a clinic would increase. Both approaches would show marked declines in the costs of illness, best represented by the incidence-based estimate. But other effects of the introduction, of course, would be to increase survival probabilities and lengthen life expectancies. As more people live longer, the number of persons in the most care-demanding ages would go up, too. So from 20 to 30 years after a cancer vaccine is introduced, it may turn out that the health-care costs in the prevalence population at large will rise and not fall, even though it would cost little to produce the vaccine.

Models for long-term analysis have been developed. There are discussions in the United Nations (1975) and in Stone (1980) of how the Markov-chain technique could be used to analyse the altered human conditions in different areas. A more detailed review of the analytical possibilities as regards the medical services and the population's state of health is to be found in Ståhl (1979). Unfortunately, there is a paucity of examples which apply the method based on factual data. Here the demands on epidemiological know-how are infinitely greater than in the calculations that have been presented in this study. Big chunks of knowledge are needed – knowledge of the kind that scarcely exists today. Obviously, this should not debar us from striving to gather the data that are already to hand. But above all, research that can build up the corpus of epidemiological knowledge should be intensified. By drawing upon this knowledge for long-term analysis we can achieve deeper insight into the often complex relationships which exist in the health-care field.

Even though all the necessary data on prevalence (or incidence) were available, the data on costs would still leave much to be desired. In the present hospital accounting system, for example, the hospital department is the basic accounting unit. This means that it is only possible to obtain data on average cost per bed day or per patient treated in a specific department from the hospital accounts. The hospital accounting system offers extremely limited possibilities of determining the costs of treatment of a specific disease or condition. Bed days are not identical even within a specific hospital department. The cost of a bed day varies in fact both between different patients and from day to day during an episode of hospital stay for a specific patient.

This study obviously had to make use of the data on bed-day costs which are presently available, when estimating the direct costs of illness by disease category. So, it was impossible to determine all the differences in treatment costs that there may be among disease categories. Better data are strongly needed. A significant improvement in the quality of cost data would arise if the individual patient replaced the hospital department as the basic accounting unit in future hospital accounting systems.

Better data on costs would also improve the possibilities of making productivity analyses. Systematic analysis of changes in health-care productivity is an important task in health-economics research. The studies summarized in Chapter 3 offer some examples of what might be done in this area. In the study on the development of inpatient somatic

care we found yearly decreases in productivity by about 3 per cent. This study was, however, based on very rough estimates of the costs per hospital stay. On the other hand, our studies on changes in the costs of cholecystectomies, inguinal hernia repair, and appendectomies were based on a very time-consuming costing method. These studies indicated two significant changes: (1) a yearly increase in the productivity of cholecystectomies by 2.0 per cent between 1955 and 1965 and (2) a yearly increase in the productivity of inguinal hernia repair by 3.7 per cent between 1965 and 1975. However, more work on the development of health-care productivity has to be done. Future studies would obviously benefit, if the necessary data were routinely collected within the health-care system.

Decreases in productivity may be a factor behind the expansion of man-hours and of current-prices expenditures in the health-care sector. Various demand factors may also be important in order to explain the expansion in the costs of health care. Despite the fact that there have been some attempts to explain this growth from the demand side, there are still many lacunae in our knowledge. The increase in population size seems to explain about 10 per cent of the growth, and so do changes in the age distribution. The influence of other demand factors is not known, however. Changes in wages, out-of-pocket charges, sickness cash benefits, *etc.* affect different persons and different health services differently, so one cannot rely on estimates based on too aggregated a model. An econometric model of the health-care sector, comprising, *inter alia*, different demand equations for inpatient care, for outpatient care, for drugs, *etc.*, and different demand equations for elderly people and young people, seems relevant as a tool for analysis of the past and for predictions of the future expansion of the health-care sector. Building such a model has been far beyond the scope of the present study, so this important task remains to be done.

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